Car Builder™

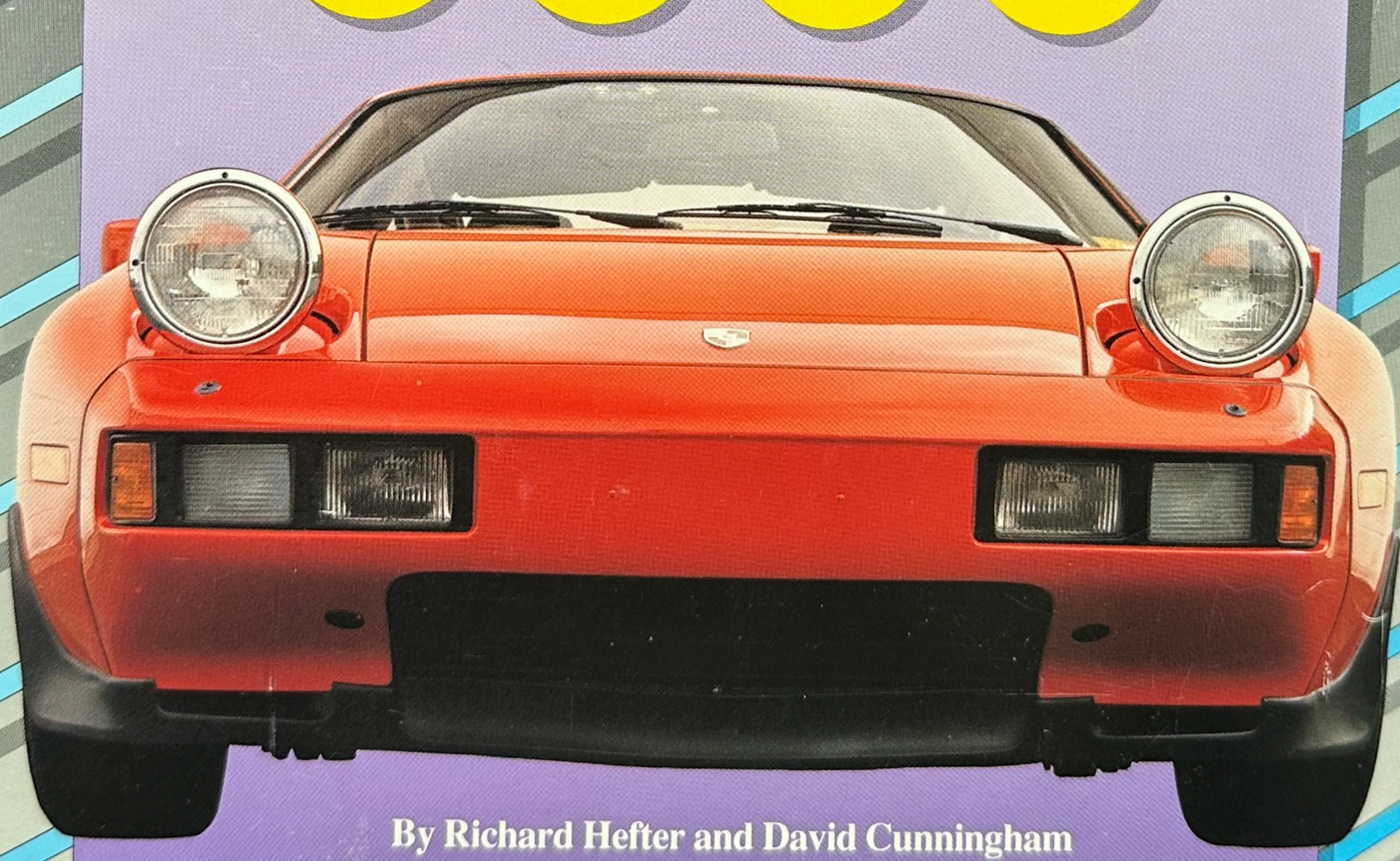
Design, construct and test your own cars!

Parents' Choice Award!

Critics' Choice Award!

Software Showcase Award!

Media & Methods Award!



By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Apple

5.25" disk included

Mac LC with Apple IIe card, IIGS, IIc+, IIc, IIe, II+, II, Laser 128 and compatibles.

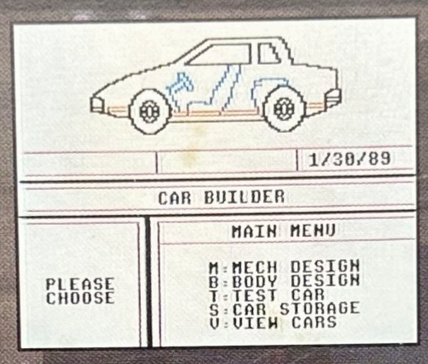
FREE 3.5" Disk Exchange Coupon!

Car Builder - The scientific simulation program that lets you design, construct, refine and test cars that you build!

Get the feel firsthand of being a car designer. With this program YOU custom design cars. Station wagon…sedan…sports car—you choose the model. Aerodynamics… racing capability…fuel efficiency—you choose the features.

"Lee Iacoca move over —here comes Car Builder!"
The CLAS Report

Product All Star
A+ Magazine



As design engineer, you select the chassis, engine, suspension system, and mechanical components.

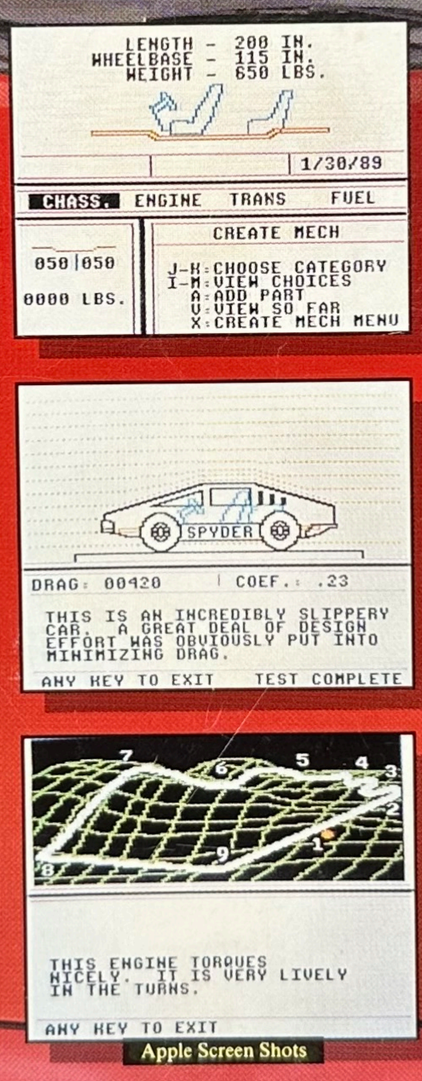
"Car Builder is great!"…*Children's Television Workshop*

"…fun to use - offers students a true challenge"
…*School Library Journal*

"…creative masterpiece of the 1980's…"
Apple - Dayton

Top 40 Software Hit
InCider Magazine

"…encourages creative thinking and problem - solving skills."
Electronic Learning


LENGTH - 200 IN.
WHEELBASE - 115 IN.
WEIGHT - 650 LBS.
1/30/89
CHASS. ENGINE TRANS FUEL
CREATE MECH
050 050
0000 LBS.
J-K:CHOOSE CATEGORY
I-M:VIEW CHOICES
A:ADD PART
V:VIEW SO FAR
X:CREATE MECH MENU
SPYDER
DRAG: 00420 COEF.: .23
THIS IS AN INCREDIBLY SLIPPERY CAR. A GREAT DEAL OF DESIGN EFFORT WAS OBVIOUSLY PUT INTO MINIMIZING DRAG.
ANY KEY TO EXIT TEST COMPLETE
THIS ENGINE TORQUES NICELY. IT IS VERY LIVELY IN THE TURNS.
ANY KEY TO EXIT

Apple Screen Shots

Now create a custom body and run your car through a full test including wind tunnel and test track, where the driver will comment on your design!

Save your car to disk for comparison with others.
There is no limit to the number of cars you can design!

Ages 8 to Adult

Photographs: Bryan Cecchi

TM and © Optimum R

MADE IN U.S.A.

Car Builder will produce hard copies of your data on most printers. 02134 594

0 31411 12100 8

Car Builder

Educational Software
from Optimum Resource

Car Builder

Design, Construct, Customize and Test Your Own Cars

Realistic Car Behavior

Educational Software
from Optimum Resource

Car Builder

Apple

Car Builder

Design, construct and test your own cars!

By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Mac LC with Apple IIe card, IIGS, IIc+, IIc, IIe, II+, II, Laser 128 and compatibles.

Disk Exchange Coupon!

FREE 3.5" Disk Exchange

Apple

5.25" disk included

Car Builder

Educational Software from Optimum Resource

Apple

Mac LC with Apple IIe card, IIGS, IIc+, IIc, IIe, II+, II, Laser 128 and compatibles.

Car Builder

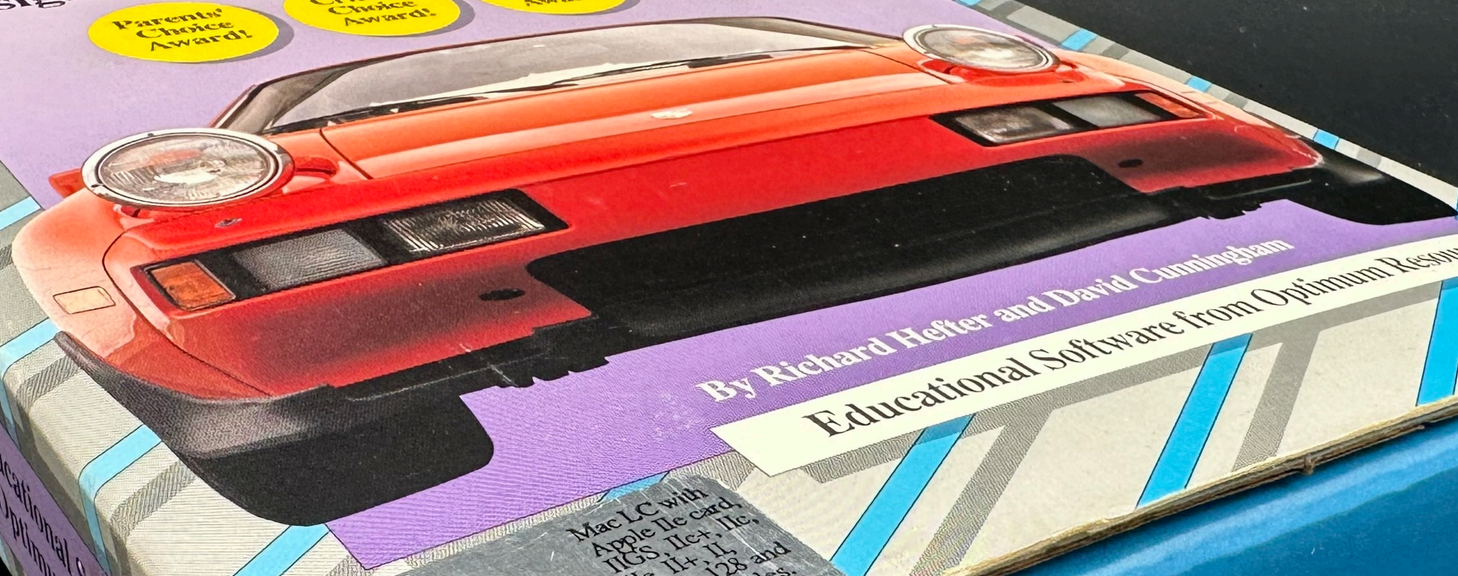
Design, construct and test your own cars!

Parents' Choice Award!

Critics' Choice Award!

Software Showcase Award!

Media Methods Awards



By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Mac LC with Apple IIe card IIGS, IIc+, IIe, IIe, II+, II, Laser 128 and compatibles.

Apple

5.25" disk included

FREE 3.5" Disk Exchange Coupon!

Car Builder

Educational Software from Optimum Resource

Apple

Mac LC with Apple IIe card IIGS, IIc+, IIe, IIe, II+, II, Laser 128 and compatibles

Car Builder™
Design, construct and test your own cars!
Parents' Choice Award!
Critics' Choice Award!
Software Showcase Award!
Media & Methods Award!
Car Builder
Educational Software from Optimum Resource

Car Builder

Educational Software
from Optimum Resource

Car Builder - The scientific simulation program that lets you design, construct, refine and test cars that you build!

Get the feel firsthand of being a car designer. With this program YOU custom design cars, Station wagon...sedan...sports car— you choose the model. Aerodynamics... racing capability...fuel efficiency— you choose the features.

As design engineer, you select the chassis, engine, suspension system, and mechanical components.

Now create a custom body and run your car through a full test including wind tunnel and test track, where the driver will comment on your design!

Save your car to disk for comparison with others. There is no limit to the number of cars you can design!

Car Builder

Educational Software
from Optimum Resource

Photographs: Bryan Cecchi

Ages 8 to Adult

Car Builder will produce hard copies of your data
on most printers. 02134

594

Car Builder™

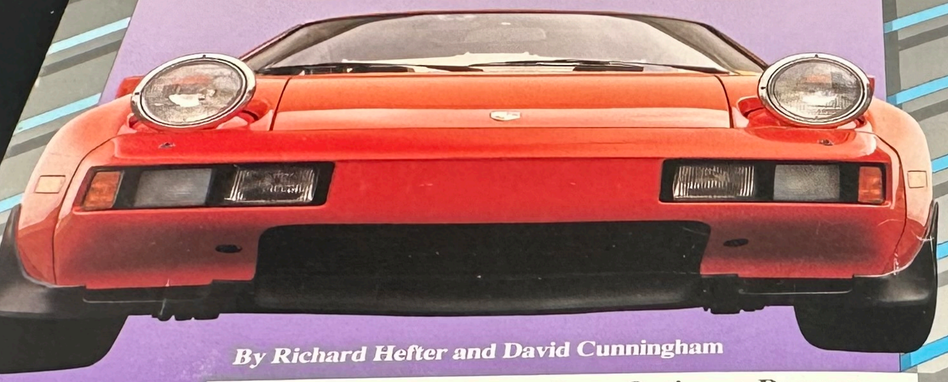
Design, construct and test your own cars!

Parents' Choice Award!

Critics' Choice Award!

Software Showcase Award!

Media & Methods Award!



By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Apple

5.25" disk included

Mac LC with Apple IIe card, IIGS, IIe+, IIc, IIe, II+, II, Laser 128 and compatibles.

FREE 3.5" Disk Exchange Coupon!

Weekly Reader Software from Optimum Resource

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Lab Pack

☐ IBM ☒ Apple ☐ Cmdr.

Optimum Resource, Inc. • Norfolk, CT 06058

Parents' Choice Award

Critics' Choice Award

By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Apple

5.25" disk included

Mac LC with Apple IIe card, IIGS, IIc+, IIe, II+, II, Laser 128 and compatibles.

FREE 3.5" Disk Exchange Coupon!

Car Builder™

Design, construct and test your own cars!

Car Builder

Educational Software from Optimum Resource

Weekly Reader Software from Optimum Resource

Car Builder

Apple 128k

® and © Optimum Resource, Inc.

Lab Pack

☐ IBM ☒ Apple ☐ Cmdr.

Optimum Resource, Inc. • Norfolk, CT 06058

Reader Software from Optimum Resource

Car Builder

Lab Pack
☐ IBM ☒ Apple ☐ Cmdr.

Optimum Resource, Inc. • Norfolk, CT 06058

Lab Pack
☐ 3.5 ☒ 5.25

Car Builder™

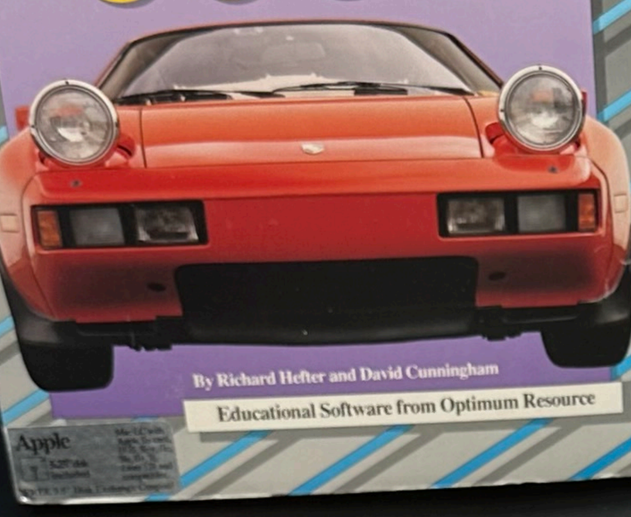
Design, construct and test your own cars!

Parents' Choice Award!

Critics' Choice Award!

Software Showcase Award!

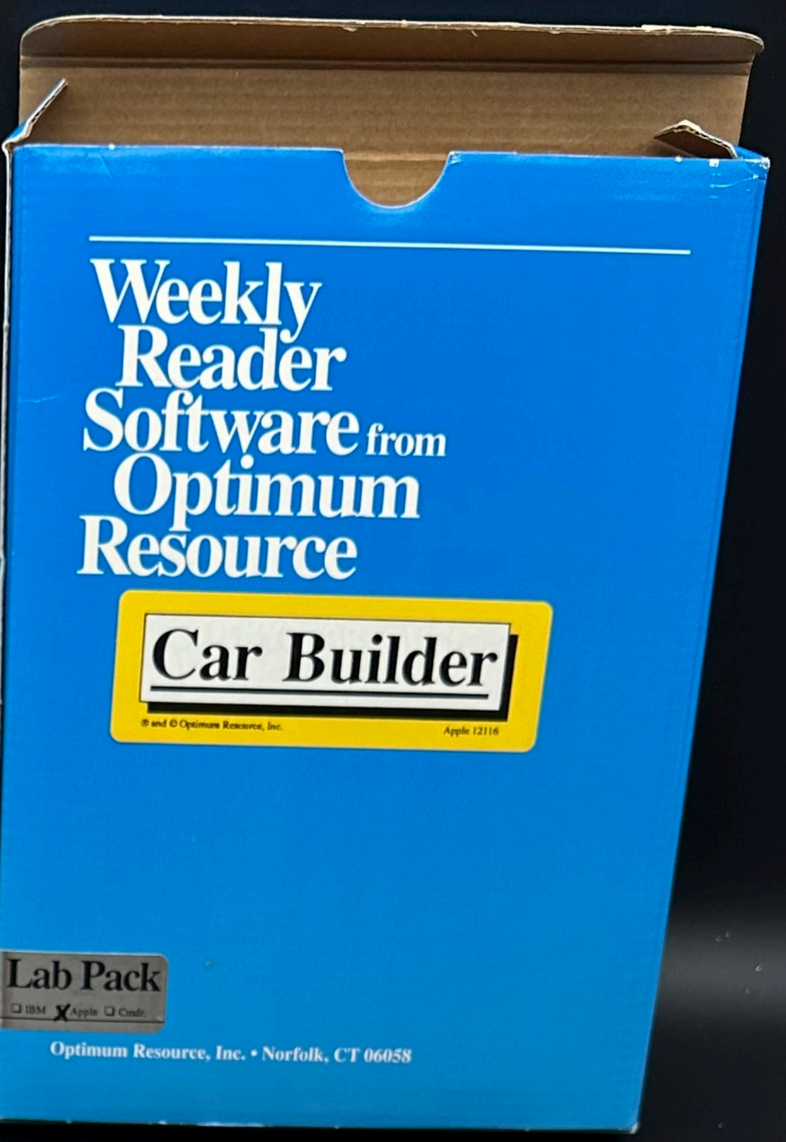
Media & Methods Award!



By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Apple


Weekly Reader Software from Optimum Resource
Car Builder
® and © Optimum Resource, Inc.
Apple 12116
Lab Pack
☐ IBM ☒ Apple ☐ Cmdr.
Optimum Resource, Inc. • Norfolk, CT 06058

This guide has been reprinted from CAR & DRIVER magazine especially for users of CAR BUILDER.

Technical Glossary

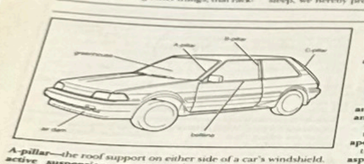
Every automotive term you wanted to know about—but were afraid to ask.

BY CSABA CSERE

"Last March, the *Wall Street Journal* ran a story about how the increasingly common use of high-tech automotive jargon in car commercials is bewildering the public. According to the article, many automotive terms that we understands to tout technical features and advancements. As proof, the *Journal* interviewed several auto shoppers and asked them to define such terms as "rack-and-pinion steering" and "double wishbones." Their responses were comical, to say the least. The author then proceeded to set the record straight, explaining, among other things, that rack-and-pinion steering consists of a gear that moves back and forth across a toothed rack. Close, but exactly backward.

That got us thinking. We know that *Car and Driver* readers are better informed than average car buyers (and certainly far better informed than *WSJ* reporters). But maybe the *Journal* was on to something. A great deal of new technology has been introduced in the past decade, and much of the terminology used to describe it is complex and difficult to understand.

So, on the off chance that there might be a term or two you can't define in your sleep, we hereby present the first installment of a three-part *Car and Driver* technical glossary. Please note that our definitions relate only to cars; don't write to us saying a "drum brake" is actually something you use to quiet the barking pervert next door. Note, too, that the **boldface** words within the definitions are themselves defined elsewhere in the glossary. Finally, be sure to keep these pages for future reference. By December you'll have all three parts of the glossary and enough technical wisdom to astonish the members of your local car club. You may even learn enough to consider a career as a *Wall Street Journal* reporter.



A-pillar—the roof support on either side of a car's windshield.

active suspension—an extremely sophisticated, computer-controlled suspension system that uses powered actuators instead of conventional springs and shock absorbers. The actuators position a car's wheels in the best possible manner to deal with road disturbances and **handling** loads.

aerodynamic drag—the drag produced by a moving object as it displaces the air in its path. Aerodynamic drag is a force usually measured in pounds; it increases in proportion to the object's frontal area, its **drag coefficient,** and the square of its speed.

air dam—a front **spoiler** mounted beneath the bumper and shaped to reduce the airflow under the car. Air dams can increase the airflow to radiators, reduce **aerodynamic drag,** and/or reduce **lift.**

anti-dive—a tuned-in front suspension characteristic that converts braking-induced forces in the suspension **links** into a vertical force that tends to lift the body, thereby reducing **dive** under braking.

anti-lock-braking system—a braking system that senses when any of the wheels have locked up, or are about to, and automatically reduces the braking forces to keep the wheels rolling. Commonly called ABS, such a system can control all four wheels or only two.

anti-roll bar—a suspension element (used at the front, the rear, or both ends of a car) that reduces body **roll** by resisting any unequal vertical motion between the pair of wheels to which it is connected. An anti-roll bar does not affect suspension stiffness when both wheels are deflected equally in the same direction. Often incorrectly called a sway bar.

anti-que—a very, very, very old car.

anti-squat—similar to **anti-dive,** this suspension characteristic uses acceleration-induced forces in the rear suspension to reduce **squat.**

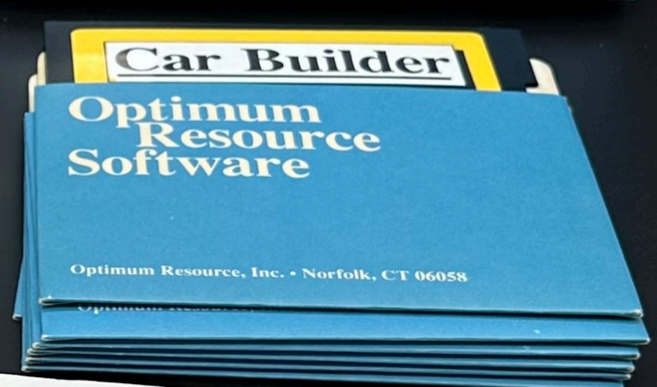
apex—the point(s) or region on the **line** through a corner that touches the corner's inner radius.

aspect ratio—generally the ratio between two dimensions of an object. In tire terminology it applies to the unloaded sidewall height of the tire divided by its overall width. A lower aspect ratio implies a shorter, wider tire. When used to describe a wing it is the span of the airfoil (the long dimension perpendicular to the airflow) divided by its chord (the dimension parallel to the airflow).

axle tramp—a sleazy woman in mechanic's overalls. It's also a form of **wheel hop** that occurs on cars with **live axles,** caused by the axle repeatedly rotating slightly with the wheels and then springing back.

B-pillar—the roof support between a car's front door window and rear side window, if there is one.

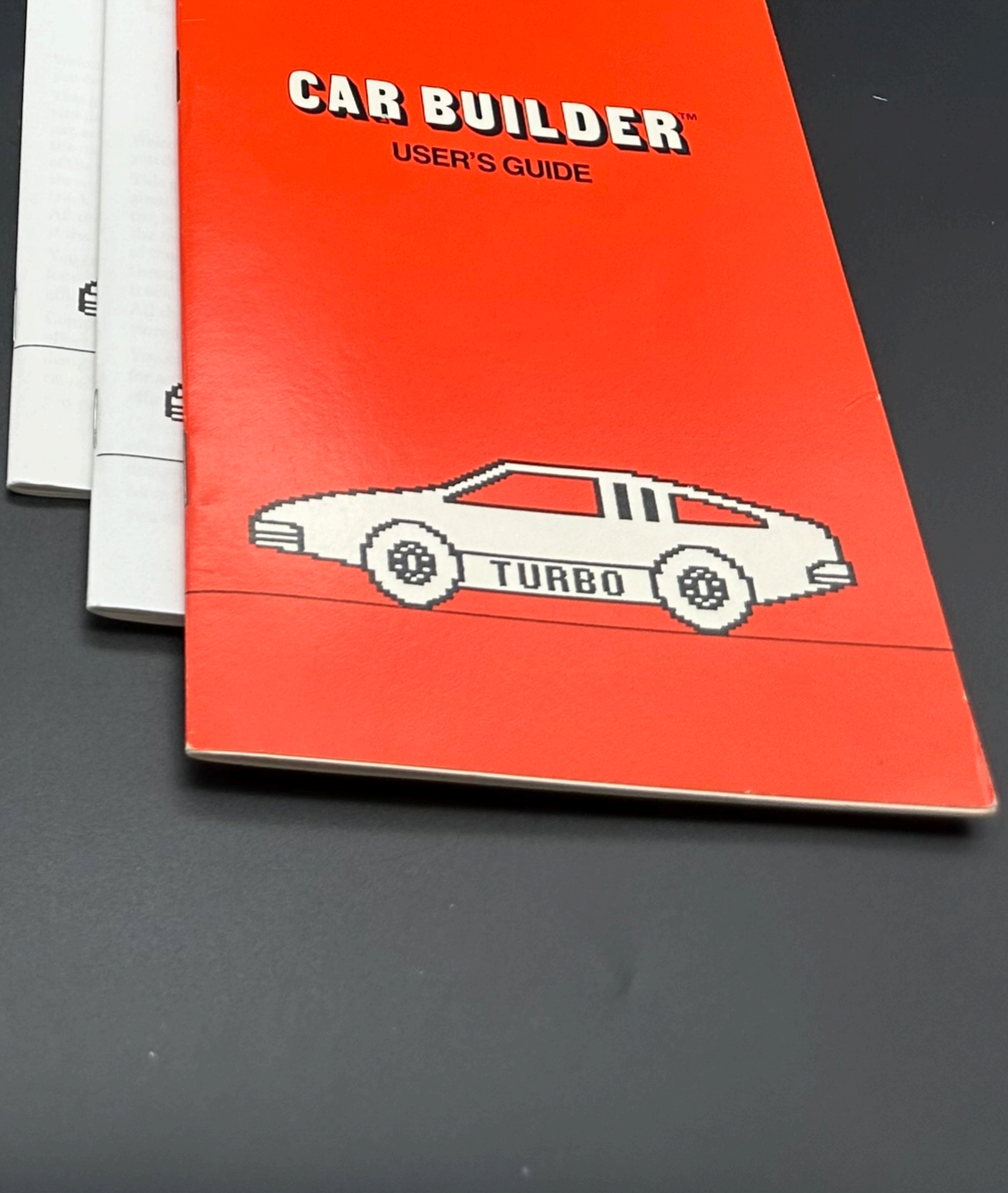
balance shaft—a shaft designed so that, as it rotates, it vibrates in a way that reduces or cancels some of the vibration produced by an engine. Not essential to an engine's operation, balance shafts are nonetheless becoming increasingly common as a means of engine refinement. Balance-shafted four-cylinder engines use two shafts turning in opposite directions on either



3.5" Disk Exchange Coupon

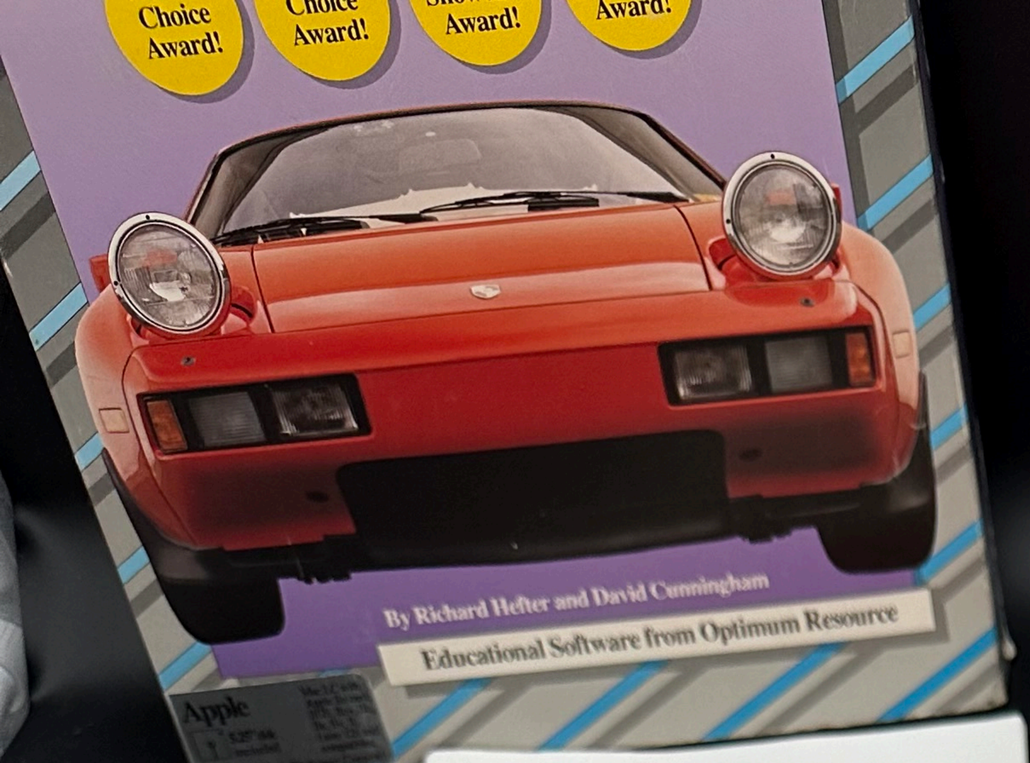
Thank you for purchasing an Optimum Resource Software program.

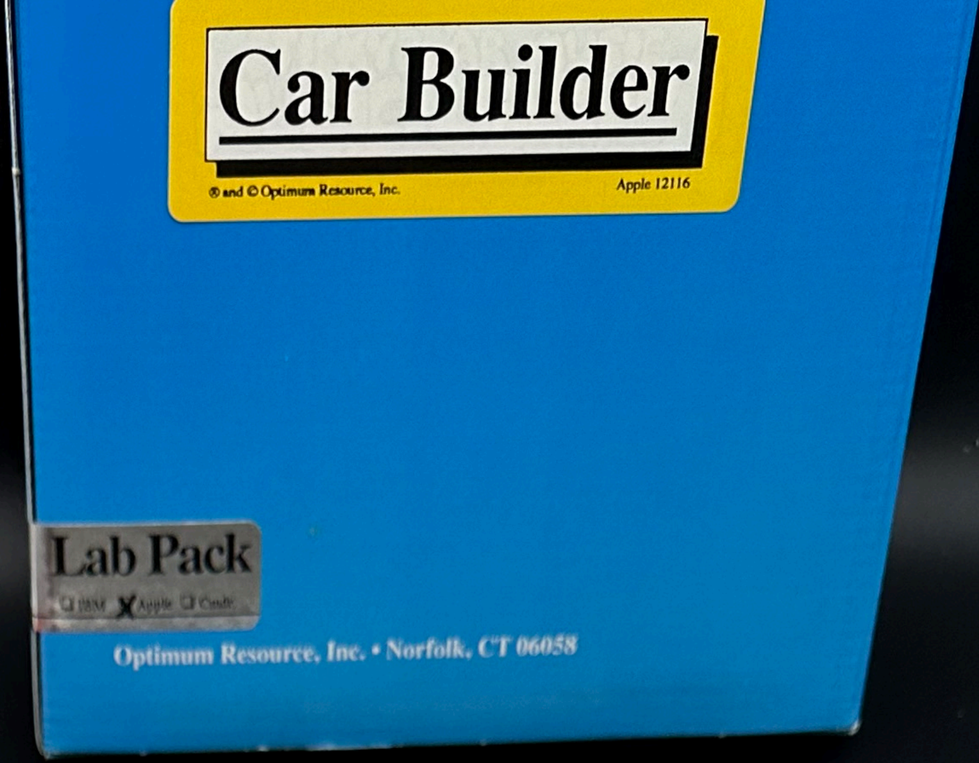
Important Optimum Resource Software Information Inside

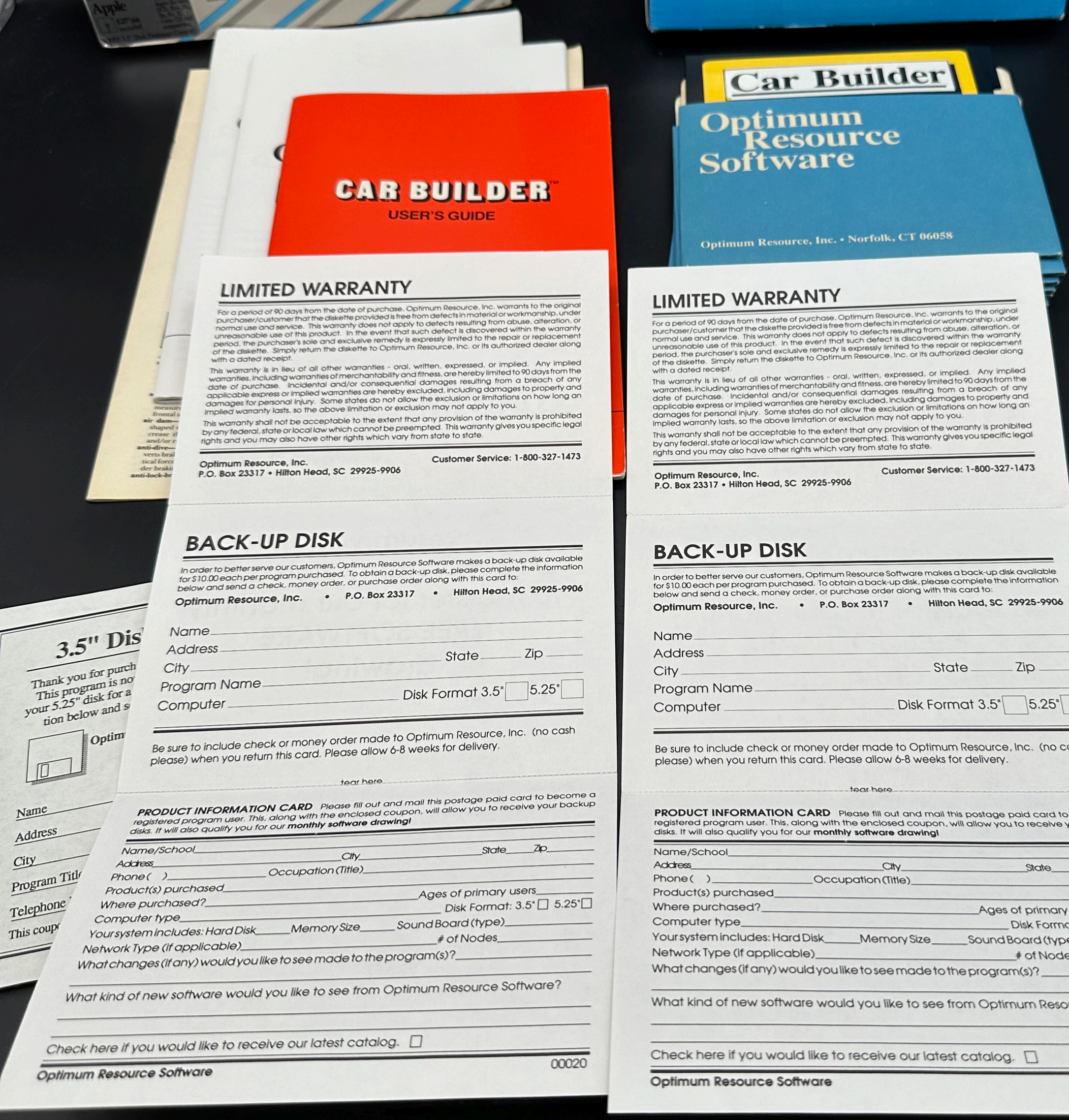


urce

Important
Optimum Resource
Software
Information
Inside


Choice Award!
Choice Award!
Award!
By Richard Hefter and David Cunningham
Educational Software from Optimum Resource
Apple


Car Builder
® and © Optimum Resource, Inc.
Apple 12116
Lab Pack
Optimum Resource, Inc. • Norfolk, CT 06058


CAR BUILDER™
USER'S GUIDE
Car Builder
Optimum Resource Software
Optimum Resource, Inc. • Norfolk, CT 06058
LIMITED WARRANTY
For a period of 90 days from the date of purchase, Optimum Resource, Inc. warrants to the original purchaser/customer that the diskette provided is free from defects in material or workmanship, under normal use and service. This warranty does not apply to defects resulting from abuse, alteration, or unreasonable use of this product. In the event that such defect is discovered within the warranty period, the purchaser's sole and exclusive remedy is expressly limited to the repair or replacement of the diskette. Simply return the diskette to Optimum Resource, Inc. or its authorized dealer along with a dated receipt.
This warranty is in lieu of all other warranties - oral, written, expressed, or implied. Any implied warranties, including warranties of merchantability and fitness, are hereby limited to 90 days from the date of purchase. Incidental and/or consequential damages resulting from a breach of any applicable express or implied warranties are hereby excluded, including damages to property and damages for personal injury. Some states do not allow the exclusion or limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you.
This warranty shall not be acceptable to the extent that any provision of the warranty is prohibited by any federal, state or local law which cannot be preempted. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.
Optimum Resource, Inc.
P.O. Box 23317 • Hilton Head, SC 29925-9906
Customer Service: 1-800-327-1473
BACK-UP DISK
In order to better serve our customers, Optimum Resource Software makes a back-up disk available for $10.00 each per program purchased. To obtain a back-up disk, please complete the information below and send a check, money order, or purchase order along with this card to:
Optimum Resource, Inc. • P.O. Box 23317 • Hilton Head, SC 29925-9906
Name
Address
City State Zip
Program Name
Computer Disk Format 3.5" 5.25"
Be sure to include check or money order made to Optimum Resource, Inc. (no cash please) when you return this card. Please allow 6-8 weeks for delivery.
tear here
PRODUCT INFORMATION CARD Please fill out and mail this postage paid card to become a registered program user. This, along with the enclosed coupon, will allow you to receive your backup disks. It will also qualify you for our monthly software drawing!
Name/School
Address City State Zip
Phone ( ) Occupation (Title)
Product(s) purchased
Where purchased? Ages of primary users
Computer type Disk Format: 3.5" 5.25"
Your system includes: Hard Disk Memory Size Sound Board (type)
Network Type (if applicable) # of Nodes
What changes (if any) would you like to see made to the program(s)?
What kind of new software would you like to see from Optimum Resource Software?
Check here if you would like to receive our latest catalog.
Optimum Resource Software
00020
3.5" Dis
Thank you for purch
This program is no
your 5.25" disk for a
tion below and s
Optim
Name
Address
City
Program Titl
Telephone
This coupo

LIMITED WARRANTY
For a period of 90 days from the date of purchase, Optimum Resource, Inc. warrants to the original purchaser/customer that the diskette provided is free from defects in material or workmanship, under normal use and service. This warranty does not apply to defects resulting from abuse, alteration, or unreasonable use of this product. In the event that such defect is discovered within the warranty period, the purchaser's sole and exclusive remedy is expressly limited to the repair or replacement of the diskette. Simply return the diskette to Optimum Resource, Inc. or its authorized dealer along with a dated receipt.
This warranty is in lieu of all other warranties - oral, written, expressed, or implied. Any implied warranties, including warranties of merchantability and fitness, are hereby limited to 90 days from the date of purchase. Incidental and/or consequential damages resulting from a breach of any applicable express or implied warranties are hereby excluded, including damages to property and damages for personal injury. Some states do not allow the exclusion or limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you.
This warranty shall not be acceptable to the extent that any provision of the warranty is prohibited by any federal, state or local law which cannot be preempted. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.
Optimum Resource, Inc.
P.O. Box 23317 • Hilton Head, SC 29925-9906
Customer Service: 1-800-327-1473
BACK-UP DISK
In order to better serve our customers, Optimum Resource Software makes a back-up disk available for $10.00 each per program purchased. To obtain a back-up disk, please complete the information below and send a check, money order, or purchase order along with this card to:
Optimum Resource, Inc. • P.O. Box 23317 • Hilton Head, SC 29925-9906
Name
Address
City State Zip
Program Name
Computer Disk Format 3.5" 5.25"
Be sure to include check or money order made to Optimum Resource, Inc. (no cash please) when you return this card. Please allow 6-8 weeks for delivery.
tear here
PRODUCT INFORMATION CARD Please fill out and mail this postage paid card to become a registered program user. This, along with the enclosed coupon, will allow you to receive your backup disks. It will also qualify you for our monthly software drawing!
Name/School
Address City State Zip
Phone ( ) Occupation (Title)
Product(s) purchased
Where purchased? Ages of primary users
Computer type Disk Format: 3.5" 5.25"
Your system includes: Hard Disk Memory Size Sound Board (type)
Network Type (if applicable) # of Nodes
What changes (if any) would you like to see made to the program(s)?
What kind of new software would you like to see from Optimum Resource Software?
Check here if you would like to receive our latest catalog.
Optimum Resource Software
00020

Educational Software from Optimum Resource

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

Optimum Resource Software

Optimum Resource, Inc. • Norfolk, CT 06058

CAR BUILDER™

USER'S GUIDE

LIMITED WARRANTY

For a period of 90 days from the date of purchase, Optimum Resource, Inc. warrants to the original purchaser/customer that the diskette provided is free from defects in material or workmanship, under normal use and service. This warranty does not apply to defects resulting from abuse, alteration, or unreasonable use of this product. In the event that such defect is discovered within the warranty period, the purchaser's sole and exclusive remedy is expressly limited to the repair or replacement of the diskette. Simply return the diskette to Optimum Resource, Inc. or its authorized dealer along with a dated receipt.

This warranty is in lieu of all other warranties - oral, written, expressed, or implied. Any implied warranties, including warranties of merchantability and fitness, are hereby limited to 90 days from the date of purchase. Incidental and/or consequential damages resulting from a breach of any applicable express or implied warranties are hereby excluded, including damages to property and damages for personal injury. Some states do not allow the exclusion or limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you.

This warranty shall not be acceptable to the extent that any provision of the warranty is prohibited by any federal, state or local law which cannot be preempted. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Optimum Resource, Inc.
P.O. Box 23317 • Hilton Head, SC 29925-9906

Customer Service: 1-800-327-1473

BACK-UP DISK

In order to better serve our customers, Optimum Resource Software makes a back-up disk available for $10.00 each per program purchased. To obtain a back-up disk, please complete the information below and send a check, money order, or purchase order along with this card to:

Optimum Resource, Inc. • **P.O. Box 23317** • **Hilton Head, SC 29925-9906**

Name _____

Address _____

City _____ State _____ Zip _____

Program Name _____

Computer _____ Disk Format 3.5" ☐ 5.25" ☐

Be sure to include check or money order made to Optimum Resource, Inc. (no cash please) when you return this card. Please allow 6-8 weeks for delivery.

tear here

PRODUCT INFORMATION CARD *Please fill out and mail this postage paid card to become a registered program user. This, along with the enclosed coupon, will allow you to receive your backup disks. It will also qualify you for our* ***monthly software drawing!***

Name/School _____

Address _____ City _____ State _____ Zip _____

Phone ( ) _____ Occupation (Title) _____

Product(s) purchased _____

Where purchased? _____ Ages of primary users _____

Computer type _____ Disk Format: 3.5" ☐ 5.25" ☐

Your system includes: Hard Disk _____ Memory Size _____ Sound Board (type) _____

Network Type (if applicable) _____ # of Nodes _____

What changes (if any) would you like to see made to the program(s)? _____

What kind of new software would you like to see from Optimum Resource Software?

Check here if you would like to receive our latest catalog. ☐

Optimum Resource Software 00020

LIMITED WARRANTY

For a period of 90 days from the date of purchase, Optimum Resource, Inc. warrants to the original purchaser/customer that the diskette provided is free from defects in material or workmanship, under normal use and service. This warranty does not apply to defects resulting from abuse, alteration, or unreasonable use of this product. In the event that such defect is discovered within the warranty period, the purchaser's sole and exclusive remedy is expressly limited to the repair or replacement of the diskette. Simply return the diskette to Optimum Resource, Inc. or its authorized dealer along with a dated receipt.

This warranty is in lieu of all other warranties - oral, written, expressed, or implied. Any implied warranties, including warranties of merchantability and fitness, are hereby limited to 90 days from the date of purchase. Incidental and/or consequential damages resulting from a breach of any applicable express or implied warranties are hereby excluded, including damages to property and damages for personal injury. Some states do not allow the exclusion or limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you.

This warranty shall not be acceptable to the extent that any provision of the warranty is prohibited by any federal, state or local law which cannot be preempted. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

Optimum Resource, Inc.
P.O. Box 23317 • Hilton Head, SC 29925-9906

Customer Service: 1-800-327-1473

BACK-UP DISK

In order to better serve our customers, Optimum Resource Software makes a back-up disk available for $10.00 each per program purchased. To obtain a back-up disk, please complete the information below and send a check, money order, or purchase order along with this card to:

Optimum Resource, Inc. • **P.O. Box 23317** • **Hilton Head, SC 29925-9906**

Name _____

Address _____

City _____ State _____ Zip _____

Program Name _____

Computer _____ Disk Format 3.5" ☐ 5.25" ☐

Be sure to include check or money order made to Optimum Resource, Inc. (no cash please) when you return this card. Please allow 6-8 weeks for delivery.

tear here

PRODUCT INFORMATION CARD Please fill out and mail this postage paid card to become a registered program user. This, along with the enclosed coupon, will allow you to receive your backup disks. It will also qualify you for our **monthly software drawing!**

Name/School _____

Address _____ City _____ State _____ Zip _____

Phone ( ) _____ Occupation (Title) _____

Product(s) purchased _____

Where purchased? _____

Computer type _____ Ages of primary users _____

Your system includes: Hard Disk _____ Memory Size _____ Sound Board (type) _____ Disk Format: 3.5" ☐ 5.25" ☐

Network Type (if applicable) _____ # of Nodes _____

What changes (if any) would you like to see made to the program(s)? _____

What kind of new software would you like to see from Optimum Resource Software?

Check here if you would like to receive our latest catalog. ☐

Optimum Resource Software 00020

CAR BUILDER
USER'S GUIDE

Optimum Resource, Inc. • Norfolk, CT 06058

3.5" Di

Thank you for pur
This program is r
your 5.25" disk for
tion below and

Opti

Name
Address
City
Program Title
Telephone No.
This coupon is v

Important
Optimum Resource
Software
Information
Inside

Return your
Product Information Card
to register for our monthly
FREE SOFTWARE
drawing!

© Optimum Resource, Inc.

PLACE STAMP
HERE.
POST OFFICE WILL
NOT DELIVER
WITHOUT ONE.

Optimum Resource, Inc.
P.O. Box 23317
Hilton Head, SC 29925-9906

Important
Optimum Resource
Software
Information
Inside

Return your
Product Information Card
to register for our monthly
FREE SOFTWARE
drawing!

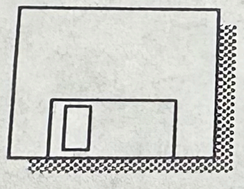
© Optimum Resource, Inc.

PLACE STAMP
HERE.
POST OFFICE WILL
NOT DELIVER
WITHOUT ONE.

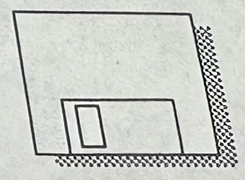
Optimum Resource, Inc.
P.O. Box 23317
Hilton Head, SC 29925-9906

3.5" Disk Exchange Coupon

Thank you for purchasing an Optimum Resource Software program. This program is now available on 3.5" media. You may exchange your 5.25" disk for a 3.5" disk at no charge. Please fill in the information below and send this coupon along with your 5.25" disk to:



Optimum Resource Software Disk Exchange
P.O. Box 23317
Hilton Head, SC 29925-9906



Name _____

Address _____

City _____ State _____ Zip _____

Program Title _____

Telephone No. _____ Computer ☐ Apple ☐ IBM/Tandy

This coupon is valid for 90 days only. After 90 days there is a $10.00 fee per disk.

Optimum Resource, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Norfolk, CT 06058

Important
Optimum R
Soft
In
Ins

Imp
Op
So
In
In

3.5" Disk F

Thank you for purchasing
This program is now ava
your 5.25" disk for a 3.5"
tion below and send t

Optimum

Name
Address
City
Program Title
Telephone No.
This coupon is val

CAR BUILDER™
User Guide

CAR BUILDER™
User Guide

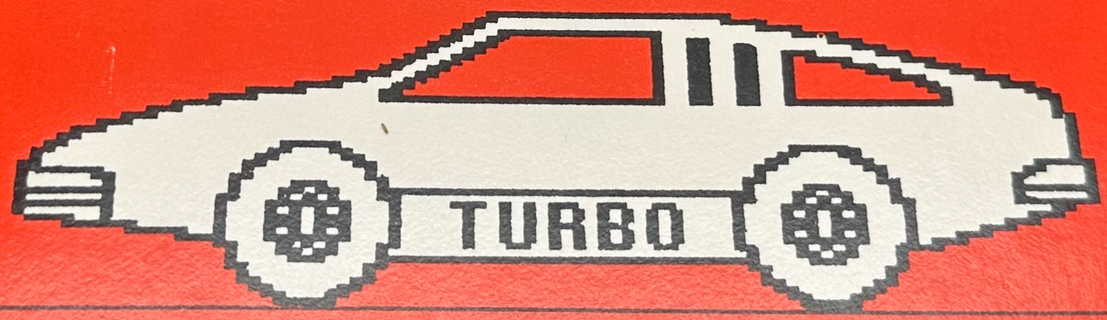
TURBO

CAR BUILDER™
USER'S GUIDE

TURBO

CAR BUILDER™

USER'S GUIDE



ILDER™

uide

Name

Address

City

Program

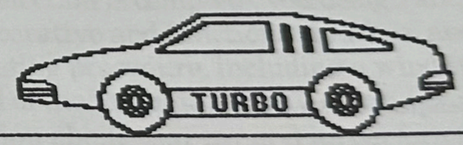
Teleph

This c

Weekly Reader
Family Software

Middletown, CT 06457

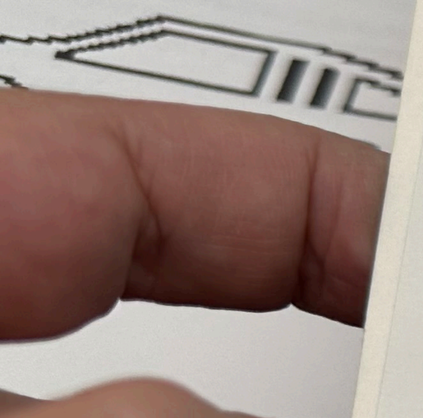
4438



CAR BUILDER™

CAR BUI

User Guid



Inside This Guide

Welcome to Car Builder 3
How To Start 4
The Main Menu 5
Mechanical Design 6
Storage Menu Options 9
Body Design 10
Body Modification 11
Testing Your Car 12
Viewing the Cars 13
Available Components 14

CAR BUILDER™
By Richard Hefter, David Cunningham, and Steve Worthington
Graphics by Robert Highsmith

Copyright © 1985 by Optimum Resource, Inc.
All rights reserved.
Printed in the United States of America.
No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any other form or by any means, electronic, mechanical, photocopying, or otherwise, without the prior written consent of the publisher.

Published by Optimum Resource, Inc., Norfolk, Connecticut.
Distributed by Weekly Reader Family Software, a division of Xerox Education Publications, 245 Long Hill Road, Middletown, CT 06457.

User's Guide written by Janie Worthington and Richard Hefter.

CAR BUILDER is the trademark of Optimum Resource, Inc.
*Apple, Apple II Plus, Apple IIc, and Apple IIe are registered trademarks of Apple Computer, Inc.

Important
Optimum R
Soft
In
Ins

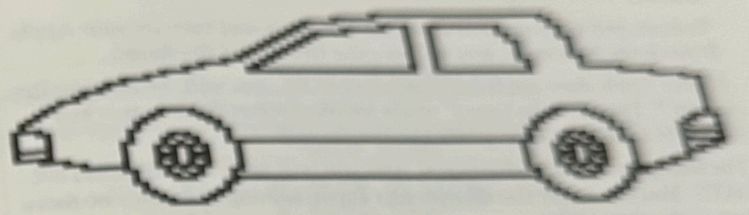
Imp
Op
So
In
In

3.5" Disk

Thank you for purcha
This program is now
your 5.25" disk for a
tion below and se

Optim

Name
Address
City
Program Title
Telephone No.
This coupon is

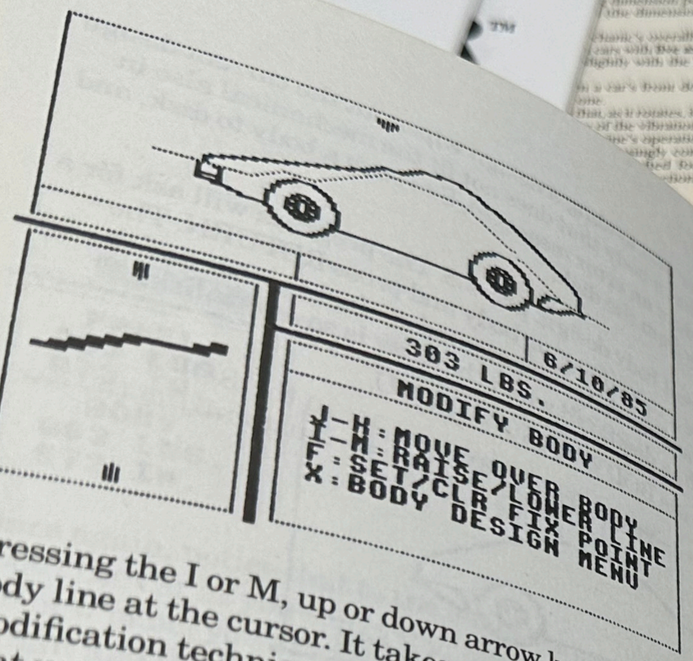


Welcome to CAR BUILDER, a scientific simulation program that lets you design, construct, modify, and test your own cars.

This guide will provide you with detailed instructions on building a simulated vehicle. First you design the mechanical (insides) of the car, selecting chassis length, fuel tank, gear ratios, tires, etc. When the mechanical selection is complete, you design and modify the body of the car, add decorative and functional touches, and run the car through a full testing procedure, including a wind tunnel and a test track. At the end of the testing section you can save your car to disk. All the information about your car and its performance will be stored, and you may view and compare your creations.

You can design station wagons, sedans, vans, and sports cars. Select for aerodynamics, power and racing ability, or economy and fuel efficiency.

Comparing the test results on modified models allows you to see the effect of improvements as you design. We have included a fully designed car, the SPYDER, on your disk. Take a look at it after you have finished your first designs. SPYDER is a hot little number, see if you can improve it.



Pressing the I or M, up or down arrow key will raise or lower the body line at the cursor. It takes practice to perfect the body modification technique; but once you get the hang of it, you will see that you can create a very wide variety of body types. You might want to try counting patterns for curved or stepped areas, such as two over, one down; two over, one down.

A series of orange lines appears across the car body in the Modify mode. These lines indicate the relative position of the mechanical (engine, chassis, etc.) portions already chosen. Modifications can be made only down to the orange line. These lines represent the top of the engine, the steering, and the seating sections of the car. If the body went below the orange line, the engine would protrude through the body.

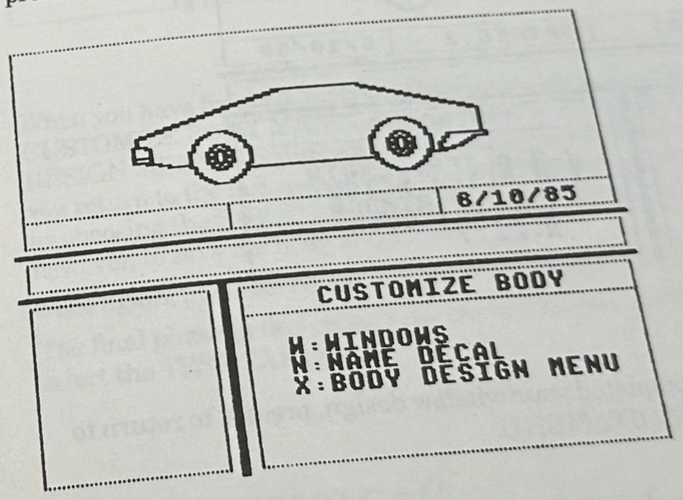
One trick that can be used when modifying a body is to press the letter F to a point along the body line. The point is represented by a green dot on the closeup section of the car. This means that that particular point can no longer move. Any subsequent modification will be made in relation to that fixed point. To clear a fixed point, just press the F key again while the arrow is directly above the green dot. There is no limit to the number of points you can fix on a car.

When all your modifications are complete, press the X key to return to the BODY DESIGN MENU. You can now choose to customize the

modified body of your car or to load in your original body design if you saved it to the disk.

To reload your original body, press the S key to access the disk options. If you choose to load in a different body from the disk, the mechanical information you have in memory at this time will remain intact. If the body you select is not compatible with the mechanical design in memory, the program will tell you to select another body or to design a new one from scratch. The modifications will be wiped out when you load a new body in from the disk.

To customize the car body, press Z while you are in the BODY DESIGN MENU. One of the available options in customizing the car body is adding windows. While in the CUSTOMIZE BODY MENU, press W to select the window option.



Important
Optimum Re
Softw
Inf
Insi

3.5" Disk Ex

Thank you for purchasing an
This program is now availa
your 5.25" disk for a 3.5" di
tion below and send this

Optimum Re

Hil

Name

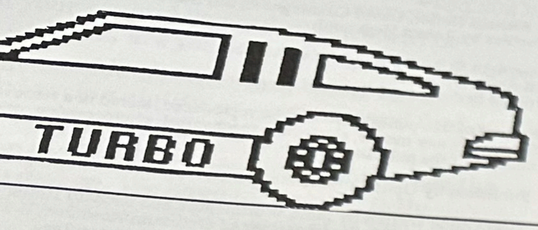
Address

City

Program Title

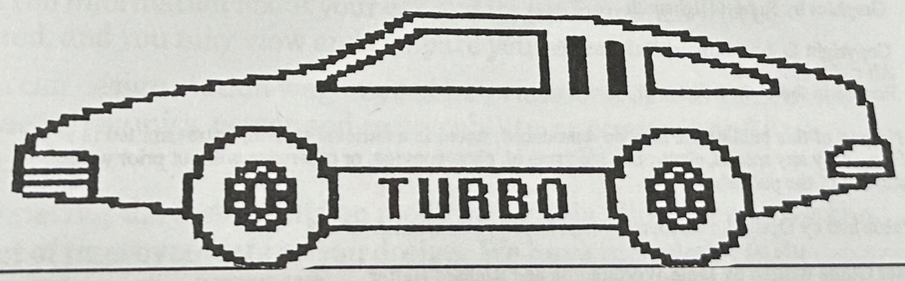
Telephone No.

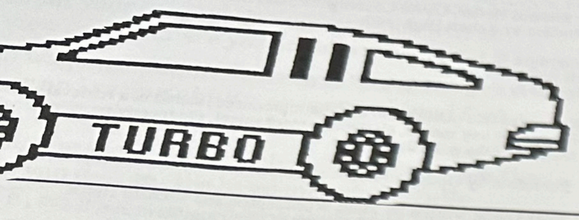
This coupon is vali



CAR BUILDER™

User Guide



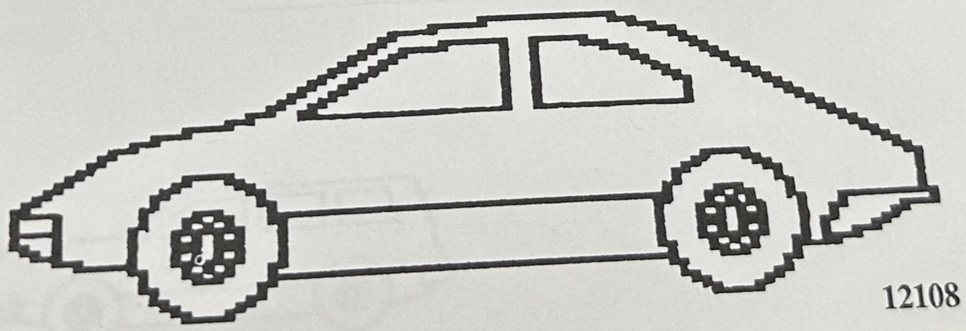


BRAKES

The larger the brake, the shorter the stopping distance. Choose the largest disk brakes for high-performance cars with heavy engines. Vented disks resist heating better than nonvented disks and will be more consistent in repeated stops.

TYPE	DIAMETER	WEIGHT (EA)
VENTED DISK	8.5 IN	75 LB
VENTED DISK	8 IN	85 LB
VENTED DISK	9.5 IN	97 LB
VENTED DISK	10 IN	110 LB
NONVENTED DISK	8.5 IN	80 LB
NONVENTED DISK	9 IN	90 LB
NONVENTED DISK	9.5 IN	100 LB
NONVENTED DISK	10 IN	120 LB
DRUM	9.5 IN	70 LB

Optimum Resource, Inc.
Norfolk, CT 06058



12108

Inside This Guide

Welcome to Car Builder 3
How to Start 4
The Main Menu 5
Mechanical Design 6
Storage Menu Options 10
Body Design 13
Body Modification 15
Testing Your Car 19
Viewing the Cars 24
Available Components 27

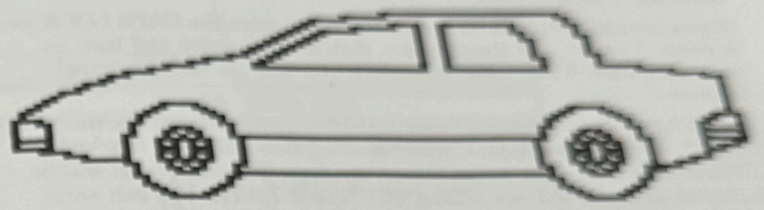
CAR BUILDER™
By Richard Hefter, David Cunningham, and Steve Worthington
Graphics by Robert Highsmith

Copyright © by Optimum Resource, Inc.
All rights reserved.
Printed in the United States of America.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, or otherwise without prior written consent of the publisher.

Published by Optimum Resource, Inc., Norfolk, Connecticut 06058

User Guide written by Janie Worthington and Richard Hefter
CAR BUILDER is the trademark of Optimum Resource, Inc.
Apple is a registered trademark of Apple Computer, Inc.

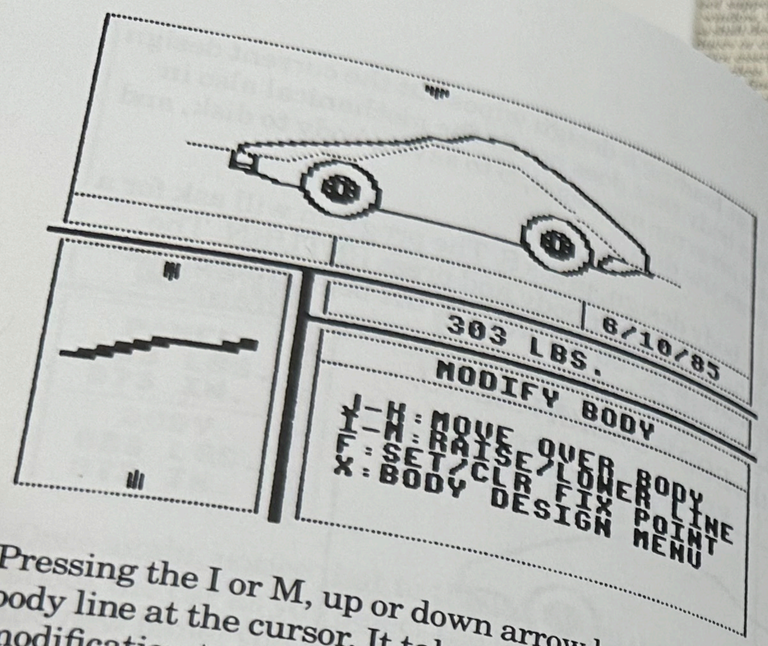


Welcome to CAR BUILDER, a scientific simulation program that lets you design, construct, modify, and test your own cars.

This guide will provide you with detailed instructions on building a simulated vehicle. First you design the mechanical (insides) of the car, selecting chassis length, fuel tank, gear ratios, tires, etc. When the mechanical selection is complete, you design and modify the body of the car, add decorative and functional touches, and run the car through a full testing procedure, including a wind tunnel and a test track. At the end of the testing section you can save your car to disk. All the information about your car and its performance will be stored, and you may view and compare your creations.

You can design station wagons, sedans, vans, and sports cars. Select for aerodynamics, power and racing ability, or economy and fuel efficiency.

Comparing the test results on modified models allows you to see the effect of improvements as you design. We have included a fully designed car, the SPYDER, on your disk. Take a look at it after you have finished your first designs. SPYDER is a hot little number, see if you can improve it.



Pressing the I or M, up or down arrow key will raise or lower the body line at the cursor. It takes practice to perfect the body modification technique; but once you get the hang of it, you will see that you can create a very wide variety of body types. You might want to try counting patterns for curved or stepped areas, such as two over, one down; two over, one down.

A series of orange lines appears across the car body in the Modify mode. These lines indicate the relative position of the mechanical (engine, chassis, etc.) portions already chosen. Modifications can be made only down to the orange line. These lines represent the top of the engine, the steering, and the seating sections of the car. If the body went below the orange line, the engine would protrude through the body.

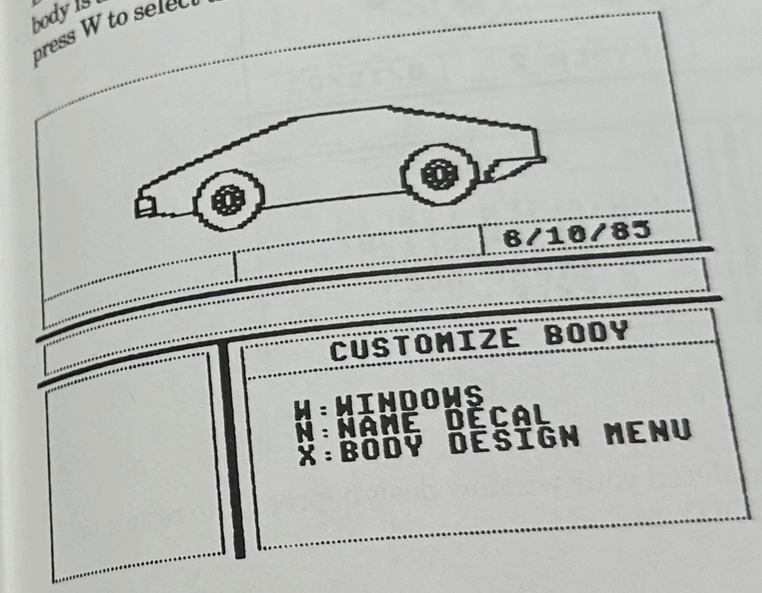
One trick that can be used when modifying a body is to press the letter F to a point along the body line. The point is represented by a green dot on the closeup section of the car. This means that that particular point can no longer move. Any subsequent modification will be made in relation to that fixed point. To clear a fixed point, just press the F key again while the arrow is directly above the green dot. There is no limit to the number of points you can fix on a car.

When all your modifications are complete, press the X key to return to the BODY DESIGN MENU. You can now choose to customize the

modified body of your car or to load in your original body design if you saved it to the disk.

To reload your original body, press the S key to access the disk options. If you choose to load in a different body from the disk, the mechanical information you have in memory at this time will remain intact. If the body you select is not compatible with the mechanical design in memory, the program will tell you to select another body or to design a new one from scratch. The modifications will be wiped out when you load a new body in from the disk.

To customize the car body, press Z while you are in the BODY DESIGN MENU. One of the available options in customizing the car body is adding windows. While in the CUSTOMIZE BODY MENU, press W to select the window option.



verts braking-induced forces in the suspension **links** into a vertical force that tends to lift the body, thereby reducing **dive** under braking.

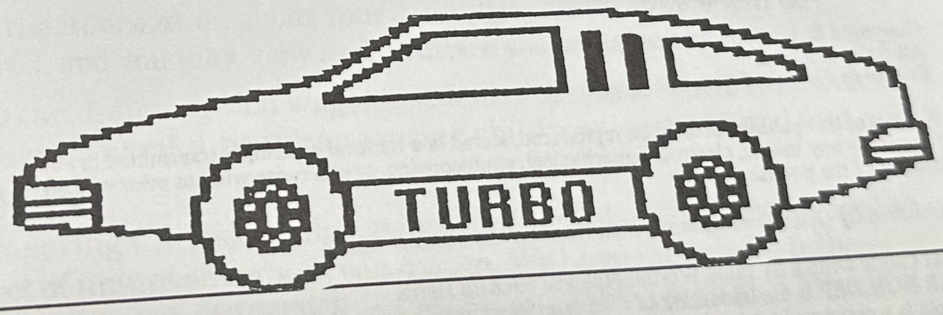
anti-lock-braking system—a braking system that senses when

and rear side window, if there is one.

balance shaft—a shaft designed so that, as it rotates, it vibrates in a way that reduces or cancels some of the vibration produced by an engine. Not essential to an engine's operation, balance shafts are nonetheless becoming increasingly common as a means of engine refinement. Balance-shafted four-cylinder engines use two shafts turning in opposite directions on either

CAR BUILDER™

User Guide



...final area, its **drag coefficient**, and the square of its speed.

air dam—a front **spoiler** mounted beneath the bumper and shaped to reduce the airflow under the car. Air dams can increase the airflow to radiators, reduce **aerodynamic drag**, and/or reduce **lift**.

anti-dive—a tuned-in front suspension characteristic that converts braking-induced forces in the suspension **links** into a vertical force that tends to lift the body, thereby reducing **dive** under braking.

anti-lock-braking system—a braking system that senses when ...

...form of **wheel hop** that occurs on cars with **live axles**, caused by the axle repeatedly rotating slightly with the wheels and then springing back.

B-pillar—the roof support between a car's front door window and rear side window, if there is one.

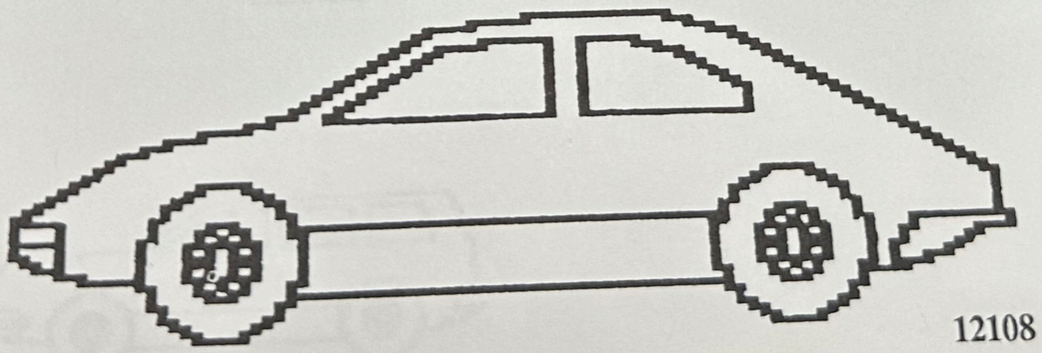
balance shaft—a shaft designed so that, as it rotates, it vibrates in a way that reduces or cancels some of the vibration produced by an engine. Not essential to an engine's operation, balance shafts are nonetheless becoming increasingly common as a means of engine refinement. Balance-shafted four-cylinder engines use two shafts turning in opposite directions on either

BRAKES

The larger the brake, the shorter the stopping distance. Choose the largest disk brakes for high-performance cars with heavy engines. Vented disks resist heating better than nonvented disks and will be more consistent in repeated stops.

TYPE	DIAMETER	WEIGHT (EA)
VENTED DISK	8.5 IN	75 LB
VENTED DISK	8 IN	85 LB
VENTED DISK	9.5 IN	97 LB
VENTED DISK	10 IN	110 LB
NONVENTED DISK	8.5 IN	80 LB
NONVENTED DISK	9 IN	90 LB
NONVENTED DISK	9.5 IN	100 LB
NONVENTED DISK	10 IN	120 LB
DRUM	9.5 IN	70 LB

Optimum Resource, Inc.
Norfolk, CT 06058



Inside This Guide

Welcome to Car Builder 1
How to Start 2
The Main Menu 2
Mechanical Design 3
Storage Menu Options 4
Body Design 5
Body Modification 6
Testing Your Car 7
Viewing the Cars 8
Available Components 9

CAR BUILDER™
By Richard Hefter, David Cunningham, and Steve Worthington
Graphics by Robert Highsmith

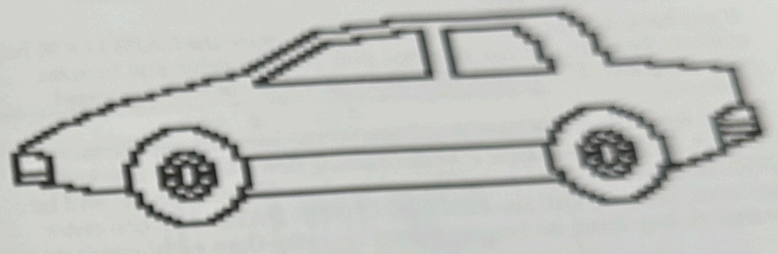
Copyright © by Optimum Resource, Inc.
All rights reserved.
Printed in the United States of America.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, or otherwise without prior written consent of the publisher.

Published by Optimum Resource, Inc., Norfolk, Connecticut 06058

User Guide written by Janie Worthington and Richard Hefter

CAR BUILDER is the trademark of Optimum Resource, Inc.
Apple is a registered trademark of Apple Computer, Inc.

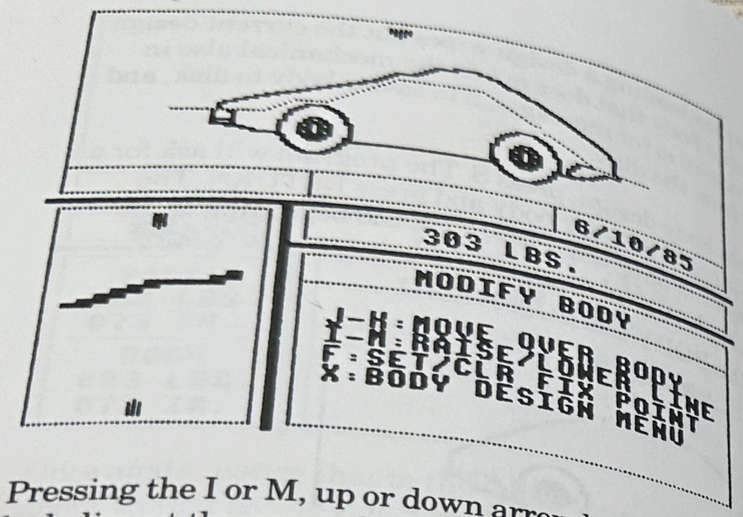


Welcome to CAR BUILDER, a scientific simulation program that lets you design, construct, modify, and test your own cars.

This guide will provide you with detailed instructions on building a simulated vehicle. First you design the mechanical (insides) of the car, selecting chassis length, fuel tank, gear ratios, tires, etc. When the mechanical selection is complete, you design and modify the body of the car, add decorative and functional touches, and run the car through a full testing procedure, including a wind tunnel and a test track. At the end of the testing section you can save your car to disk. All the information about your car and its performance will be stored, and you may view and compare your creations.

You can design station wagons, sedans, vans, and sports cars. Select for aerodynamics, power and racing ability, or economy and fuel efficiency.

Comparing the test results on modified models allows you to see the effect of improvements as you design. We have included a fully designed car, the SPYDER, on your disk. Take a look at it after you have finished your first designs. SPYDER is a hot little number, see if you can improve it.



Pressing the I or M, up or down arrow key will raise or lower the body line at the cursor. It takes practice to perfect the body modification technique; but once you get the hang of it, you will see that you can create a very wide variety of body types. You might want to try counting patterns for curved or stepped areas, such as two over, one down; two over, one down.

A series of orange lines appears across the car body in the Modify mode. These lines indicate the relative position of the mechanical (engine, chassis, etc.) portions already chosen. Modifications can be made only down to the orange line. These lines represent the top of the engine, the steering, and the seating sections of the car. If the body went below the orange line, the engine would protrude through the body.

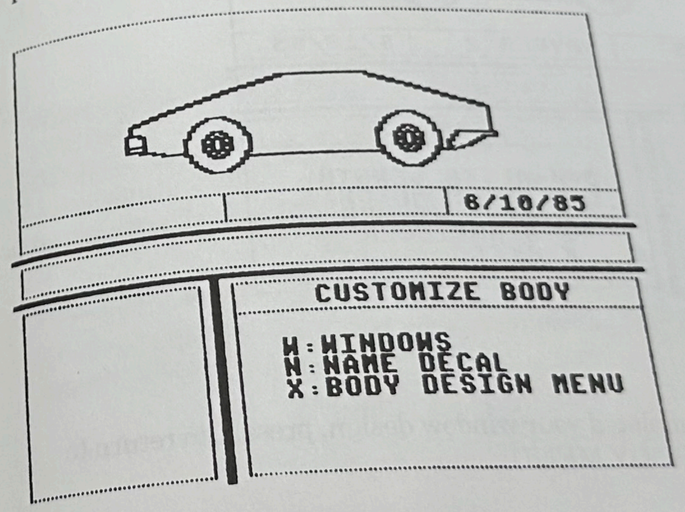
One trick that can be used when modifying a body is to press the letter F to a point along the body line. The point is represented by a green dot on the closeup section of the car. This means that that particular point can no longer move. Any subsequent modification will be made in relation to that fixed point. To clear a fixed point, just press the F key again while the arrow is directly above the green dot. There is no limit to the number of points you can fix on a car.

When all your modifications are complete, press the X key to return to the BODY DESIGN MENU. You can now choose to customize the

modified body of your car or to load in your original body design if you saved it to the disk.

To reload your original body, press the S key to access the disk options. If you choose to load in a different body from the disk, the mechanical information you have in memory at this time will remain intact. If the body you select is not compatible with the mechanical design in memory, the program will tell you to select another body or to design a new one from scratch. The modifications will be wiped out when you load a new body in from the disk.

To customize the car body, press Z while you are in the BODY DESIGN MENU. One of the available options in customizing the car body is adding windows. While in the CUSTOMIZE BODY MENU, press W to select the window option.



This guide has been reprinted
from CAR & DRIVER magazine
especially for users of
CAR BUILDER.

Technical Glossary

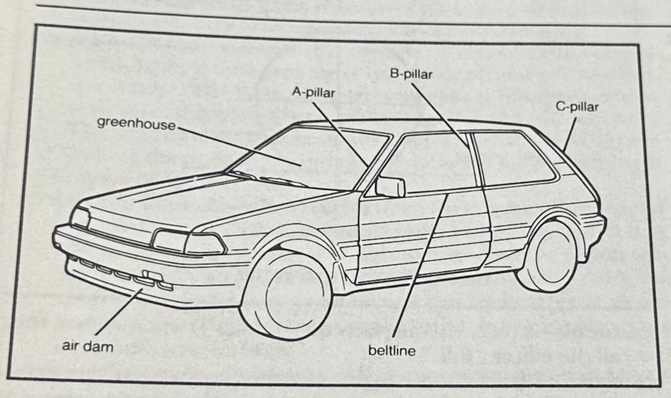
Every automotive term you wanted to know about—but were afraid to ask.

BY CSABA CSERE

• Last March, the *Wall Street Journal* ran a story about how the increasingly common use of high-tech automotive jargon in car commercials is bewildering the public. According to the article, many automotive advertisements use impressive-sounding terms that no one understands to tout technical features and advancements. As proof, the *Journal* interviewed several auto shoppers and asked them to define such terms as "rack-and-pinion steering" and "double wishbones." Their responses were comical, to say the least. The author then proceeded to set the record straight, explaining, among other things, that rack-and-pinion steering consists of a gear that moves back and forth across a toothed rack. Close, but exactly backward.

That got us thinking. We know that *Car and Driver* readers are better informed than average car buyers (and certainly far better informed than *WSJ* reporters). But maybe the *Journal* was on to something. A great deal of new technology has been introduced in the past decade, and much of the terminology used to describe it is complex and difficult to understand.

So, on the off chance that there might be a term or two you can't define in your sleep, we hereby present the first installment of a three-part *Car and Driver* technical glossary. Please note that our definitions relate only to cars: don't write to us saying a "drum brake" is actually something you use to quiet the budding percussionist next door. Note, too, that the **boldface** words within the definitions are themselves defined elsewhere in the glossary. Finally, be sure to keep these pages for future reference. By December you'll have all three parts of the glossary and enough technical wisdom to astonish the members of your local car club. You may even learn enough to consider a career as a *Wall Street Journal* reporter.



A-pillar—the roof support on either side of a car's windshield.

active suspension—an extremely sophisticated, computer-controlled suspension system that uses powered actuators instead of conventional springs and shock absorbers. The actuators position a car's wheels in the best possible manner to deal with road disturbances and **handling** loads.

aerodynamic drag—the drag produced by a moving object as it displaces the air in its path. Aerodynamic drag is a force usually measured in pounds; it increases in proportion to the object's frontal area, its **drag coefficient,** and the square of its speed.

air dam—a front **spoiler** mounted beneath the bumper and shaped to reduce the airflow under the car. Air dams can increase the airflow to radiators, reduce **aerodynamic drag,** and/or reduce **lift.**

anti-dive—a tuned-in front suspension characteristic that converts braking-induced forces in the suspension **links** into a vertical force that tends to lift the body, thereby reducing **dive** under braking.

anti-lock-braking system—a braking system that senses when any of the wheels have locked up, or are about to, and automatically reduces the braking forces to keep the wheels rolling. Commonly called ABS, such a system can control all four wheels or only two.

anti-roll bar—a suspension element (used at the front, the rear, or both ends of a car) that reduces body **roll** by resisting any unequal vertical motion between the pair of wheels to which it is connected. An anti-roll bar does not affect suspension stiffness when both wheels are deflected equally in the same direction. Often incorrectly called a sway bar.

anti-que—a very, very, very old car.

anti-squat—similar to **anti-dive,** this suspension characteristic uses acceleration-induced forces in the rear suspension to reduce **squat.**

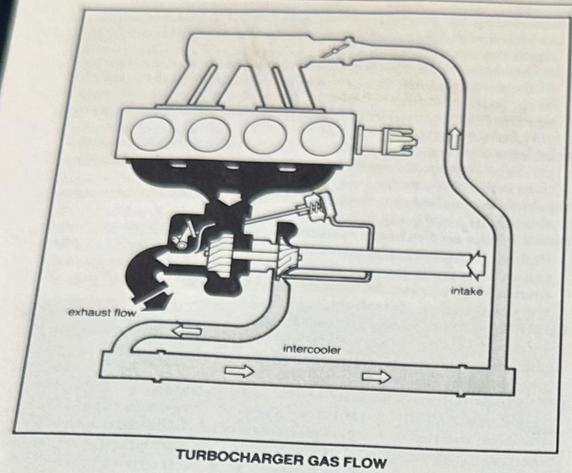
apex—the point(s) or region on the **line** through a corner that touches the corner's inner radius.

aspect ratio—generally the ratio between two dimensions of an object. In tire terminology it applies to the unloaded sidewall height of the tire divided by its overall width. A lower aspect ratio implies a shorter, wider tire. When used to describe a wing it is the span of the airfoil (the long dimension perpendicular to the airflow) divided by its chord (the dimension parallel to the airflow).

axle tramp—a sleazy woman in mechanic's overalls. It's also a form of **wheel hop** that occurs on cars with **live axles,** caused by the axle repeatedly rotating slightly with the wheels and then springing back.

B-pillar—the roof support between a car's front door window and rear side window, if there is one.

balance shaft—a shaft designed so that, as it rotates, it vibrates in a way that reduces or cancels some of the vibration produced by an engine. Not essential to an engine's operation, balance shafts are nonetheless becoming increasingly common as a means of engine refinement. Balance-shafted four-cylinder engines use two shafts turning in opposite directions on either



TURBOCHARGER GAS FLOW

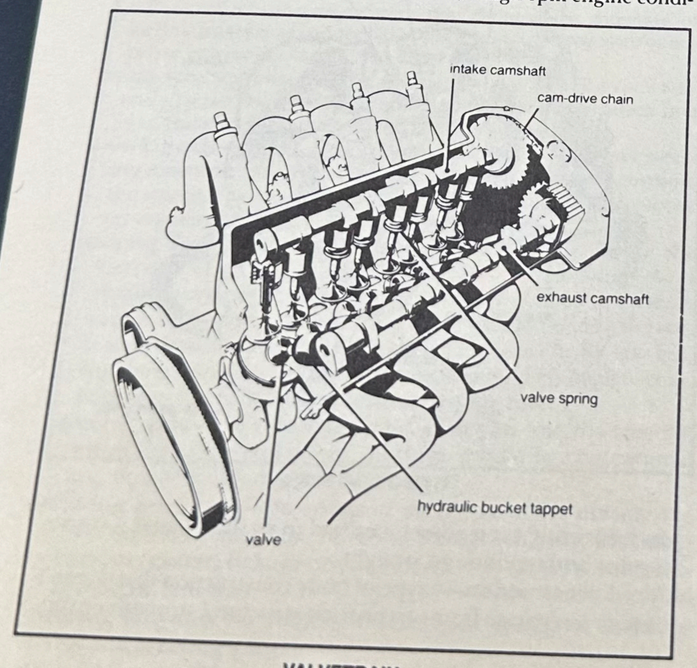
port for the car's mechanical components. A unitized body can employ **monocoque** construction, or it can utilize strong structural elements as an integral part of its construction.

universal joint—a joint that transmits rotary motion between two shafts that aren't in a straight line. Depending on its design, a universal joint can accommodate a large angular variation between its inputs and outputs. The simplest kind of universal joint, called a "Hooke joint," causes the output shaft to speed up and slow down twice for every revolution of the input shaft. This speed fluctuation increases with the angular difference between the shafts.

valve float—mix two cups of root beer, a scoop of vanilla ice cream, and add valves to taste. Also, a high-rpm engine condition in which the **valve lifters** lose contact with the cam lobes because the valve springs are not strong enough to overcome the momentum of the various **valvetrain** components. The onset of valve float prevents higher-rpm operation. Extended periods of valve float will damage the valvetrain.

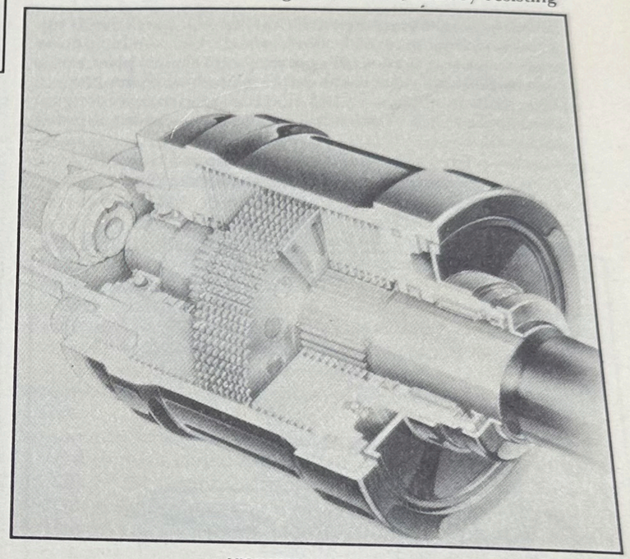
valve lifter—also called a "valve follower"—the cylindrically shaped component that presses against the lobe of a **camshaft** and moves up and down as the cam lobe rotates. Most valve lifters have an oil-lubricated hardened face that slides on the cam lobe. So-called "roller lifters," however, have a small roller in contact with the cam lobe—thereby reducing the friction between the cam lobe and the lifter.

valvetrain—the collection of parts that make the valves operate. The valvetrain includes the **camshaft(s)** and all related drive components, the various parts that convert the camshaft's rotary motion into reciprocating motion at the valves, and the valves and their associated parts.



VALVETRAIN

viscous coupling—a particular kind of **fluid coupling** in which the input and output shafts mate with thin, alternately spaced discs in a cylindrical chamber. The chamber is filled with a viscous fluid that tends to cling to the discs, thereby resisting



VISCOUS COUPLING

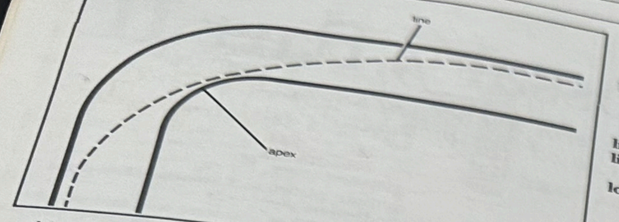
speed differences between the two shafts. Viscous couplings are used to limit the speed difference between the two outputs of a **differential,** or between the two axles of a car.

waste gate—a valve used to limit the **boost** developed in a **turbocharger.** A waste gate operates by allowing some of the engine's exhaust flow to bypass the turbocharger's turbine section under certain conditions.

wheel hop—an undesirable suspension characteristic in which a wheel (or several) moves up and down so violently that it actually leaves the ground. Wheel hop can be caused by many problems, including excessive unsprung weight, insufficient shock damping, or poor torsional axle control.

yaw—the rotation about a vertical axis that passes through the car's **center of gravity.**

zero-offset steering—a steering system whose geometry has a **scrub radius** of zero. This configuration minimizes the steering effects produced during acceleration (with front drive) or braking on varying traction surfaces.



driver. Mechanically controlled instruments almost always feature analog displays (usually needles-and-numbers dials). Electronically controlled instruments use analog displays, digital readouts, or even graphics panels.

intake charge—the mixture of fuel and air that flows into the engine.

intake manifold—the network of passages that direct air or air-fuel mixture from the **throttle body** to the **intake ports** in the **cylinder head.** The flow typically proceeds from the throttle body into a chamber called the **plenum,** which in turn feeds individual tubes, called runners, leading to each intake port. Engine **breathing** is enhanced if the intake manifold is configured to optimize the pressure pulses in the intake system.

intake port—the passageway in a **cylinder head** leading from the **intake manifold** to the intake valve(s).

intercooler—a heat exchanger that cools the air (or, in some installations, the **intake charge**) that has been heated by compression in any type of **supercharger.** An intercooler resembles a radiator; it houses large passages for the intake flow, and uses either outside air or water directed over it to lower the temperature of the intake flow inside.

jounce—the motion of a wheel that compresses its suspension.

jounce bumper—an elastic cushion used to stiffen the suspension gradually as it approaches the end of its **jounce** travel.

Kevlar—a very flexible, strong, light, and abrasion-resistant artificial fiber, manufactured by Du Pont, that can be combined with a plastic resin to produce an efficient **composite** material.

kickdown—a downshift in an automatic **transmission** caused by depressing the throttle.

knock sensor—a sensor mounted on the engine that is designed to detect the high-frequency vibrations caused by **detonation.** By employing a knock sensor, a computerized **engine-control system** allows an engine to operate very near its detonation limit—thereby improving **power** and efficiency.

lateral link—a suspension **link** that is aligned to resist sideways motions in a wheel.

leading link—a suspension **link** that is aligned to resist longitudinal motions in a wheel; it is mounted to the **chassis** behind the wheel.

leaf spring—a long, flat, thin, flexible piece of spring steel or various **composite** materials that deflects by bending when forces act upon it. Leaf springs are used primarily in suspensions.

lift—a vertical force directed upward, produced by the airflow around a moving object—such as a car body.

throttle oversteer—a **handling** characteristic that causes the rear tires to lose some of their cornering grip when the throttle is released during hard cornering.

limited-slip differential—a **differential** fitted with a mechanism that limits the speed and **torque** differences between its two outputs. Limited slip ensures that some torque is always distributed to both wheels, even when one is on very slippery pavement.

line—a lecherous phrase, such as "Hey, baby, have you seen that mags on my '71 Challenger R/T?" Also, the path through a corner that best accommodates a late-braking point, a high cornering speed, and the fastest-possible exit speed.

link—a suspension member that has a single joint at each end.

live axle—a **rigid axle** incorporating a **differential** and axle shafts to power the two wheels it is supporting.

lockup—the juncture at which a tire starts to skid during braking. A tire's maximum braking force is developed when it is on the verge of lockup, so a car's shortest stopping distances are produced when its front and rear tires approach lockup conditions simultaneously. This is very hard to achieve under varying conditions of load and traction, so one end typically locks up before the other. Front-wheel lockup is inherently more stable than rear-wheel lockup.

lockup differential—a **differential** whose two outputs can be locked together, eliminating any differential action but maximizing traction under slippery conditions.

lockup torque converter—a **torque converter** fitted with a lockup clutch that can be engaged to eliminate the slip between the torque converter's input and output, thereby improving fuel efficiency and performance.

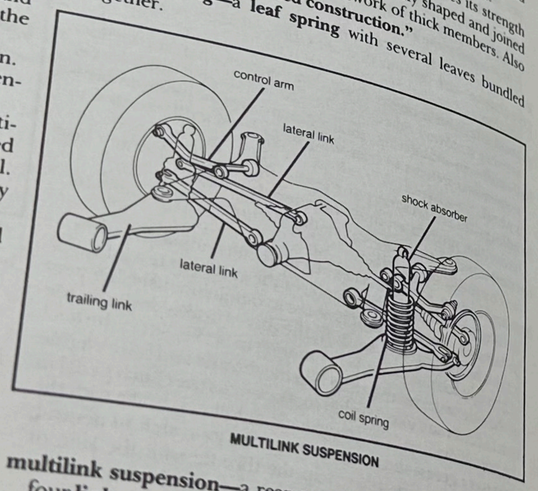
loose—a slang term for **oversteer.** Also . . . well, you know.

main bearings—the bearings in an engine block that support the **crankshaft.**

mid-engine—a **chassis** layout that positions the engine behind the passenger compartment but ahead of the rear axle.

monocoque—a type of body structure that derives its strength and rigidity from the use of thin, carefully shaped and joined panels, rather than from a framework of thick members. Also called "unit" or **"unitized construction."**

multileaf spring—a **leaf spring** with several leaves bundled together.



MULTILINK SUSPENSION

multilink suspension—a rear suspension consisting of at least four **links,** or "arms," and no **struts.** Because multilink suspensions assign specific wheel-locating duties to each element, they provide great flexibility for optimizing both ride and **handling.**

neutral steer—a cornering condition in which the front and rear **slip angles** are roughly the same. Although seemingly an ideal state of balance, perfect neutral steer is not as stable as slight **understeer.**

on-center feel—the responsiveness and feel of the steering when the wheel is approximately centered. In a car with good on-center feel, the steering wheel tends to return to center when slightly deflected, assisting straight-line stability.

opposite lock—a technique in which the steering wheel is turned in the direction away from where the car is turning. Opposite lock is used to control a car when it is **oversteering** and its tail is swinging wide.

overdrive—any **gearset** in which the output shaft turns faster than the input shaft. Overdrive gears are used in most modern **transmissions** because they reduce engine rpm and improve fuel economy. Occasionally, a separate gearbox with an overdrive gearset is coupled to a conventional transmission.

overhead cam—the type of **valvetrain** arrangement in which the engine's **camshaft(s)** is in its **cylinder head(s).** When the camshaft(s) is placed close to the valves, the valvetrain components can be stiffer and lighter, allowing the valves to open and close more rapidly and the engine to run at higher rpm. In a single-overhead-cam (**SOHC**) layout, one camshaft actuates all of the valves in a cylinder head. In a double-overhead-camshaft (**DOHC**) layout, one camshaft actuates the intake valves, and one camshaft operates the exhaust valves.

oversquare—Pat Boone. Also, a description of an engine whose **bore** is larger than its **stroke.**

oversteer—a **handling** condition in which the **slip angles** of the rear tires are greater than the slip angles of the front tires. An oversteering car is sometimes said to be **"loose,"** because its tail tends to swing wide.

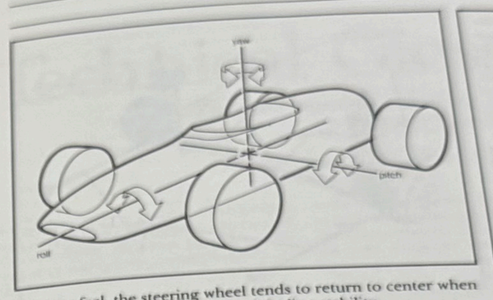
Panhard rod—a long **lateral link** that provides lateral location of a **rigid axle.** It usually sits roughly parallel to the axle, with one end attached to the body and the other attached to the axle.

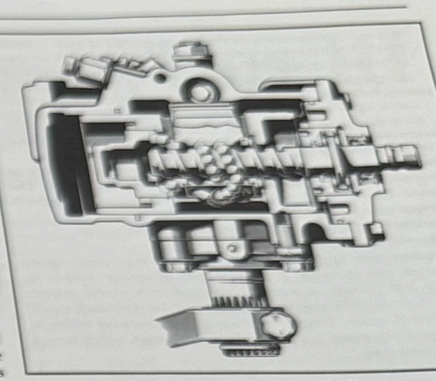
pent-roof—a **combustion chamber** whose upper surface resembles a shallow peaked roof. Usually used with **four valves per cylinder.**

pitch—the rotation of a car about a horizontal axis, which causes its nose or tail to bob up and down. **Dive** and **squat** are pitching motions.

planetary gears—a **gearset** in which all of the gears are in one plane, grouped around each other like the planets around the sun. The central gear is called the "sun gear." In mesh with it is a circular grouping of gears, called "planet gears," mounted on a rotating carrier. The planet gears also engage teeth on the inner periphery of the "ring gear." By holding any one of the three gear elements motionless, different ratios can be produced between the other two. Planetary gearsets are common in automatic **transmissions.**

plenum chamber—a chamber, located between the **throttle body** and the runners of an **intake manifold,** used to distribute the **intake charge** evenly and to enhance engine **breathing.**

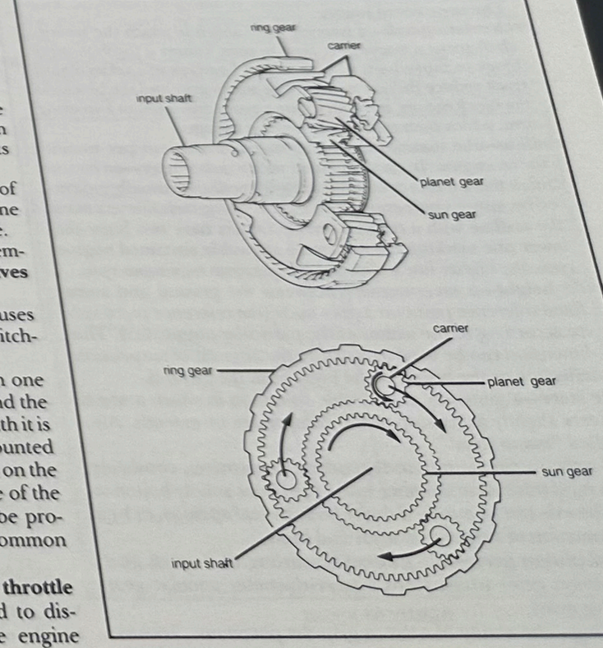




RECIRCULATING-BALL STEERING

polar moment of inertia—the resistance of an object to rotational acceleration. When the mass of an object is distributed far from its axis of rotation, the object is said to have a high polar moment of inertia. When the mass distribution is close to the axis of rotation, it has a low polar moment of inertia. A **mid-engined** car has most of its mass within its wheelbase, contributing to a low polar moment of inertia, which, in turn, improves cornering **turn-in.**

port fuel injection—the phenomenon that occurs when sailors go ashore for dinner. Also, a type of **fuel injection** with at least



PLANETARY GEARSET

By Richard Hefter and David Cunningham

Educational Software from Optimum Resource

Apple

Lab Pack

Optimum Resource, Inc. • Norfolk, CT 06058

3.5" Disk Exchange Coupon

Optimum Resource Software Disk Exchange
P.O. Box 23317
Hilton Head, SC 29925-9906

Car Builder

Optimum Resource Software

Optimum Resource, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Norfolk, C

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Optimum Resource Software

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Optimum Resource Software

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Optimum Resource Software

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

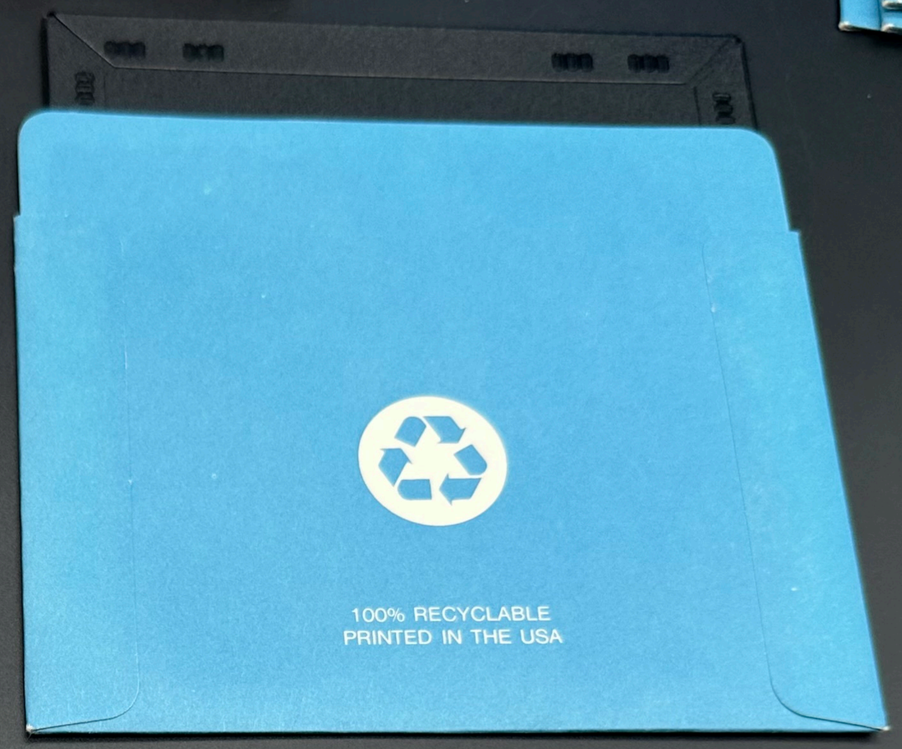
® and © Optimum Resource, Inc. Apple 12116

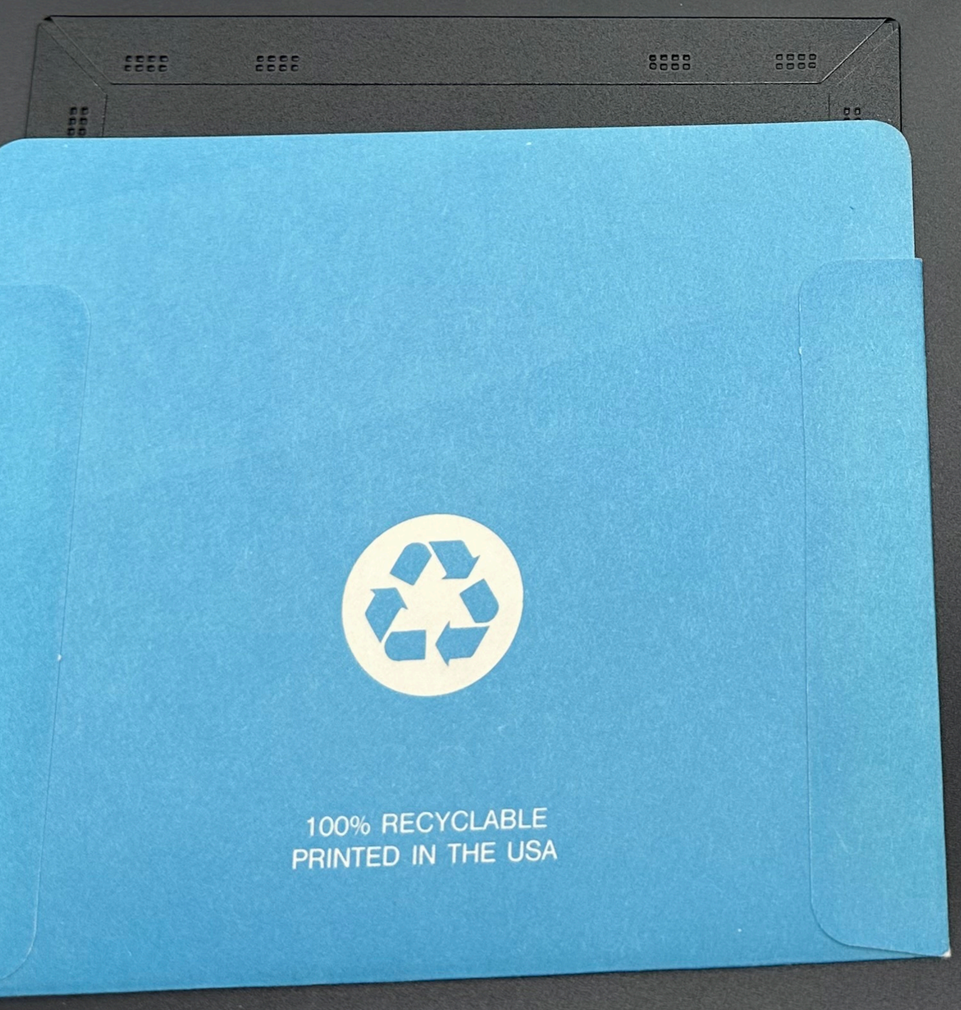
Optimum Resource Software

Optimum Resource, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Norfo

100% RECYCLABLE
PRINTED IN THE USA


100% RECYCLABLE
PRINTED IN THE USA


100% RECYCLABLE
PRINTED IN THE USA

100% RECYCLABLE
PRINTED IN THE USA

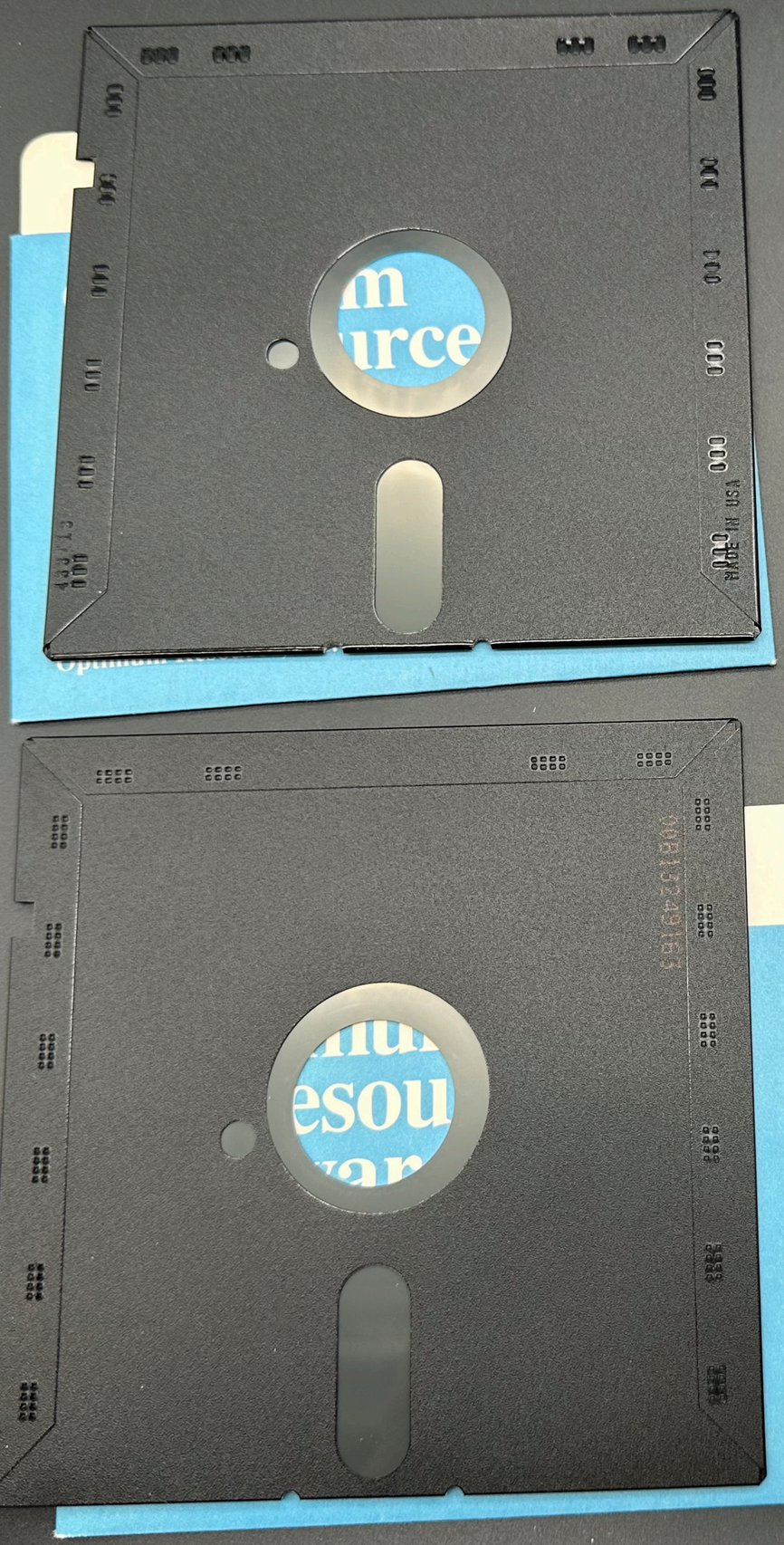
Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder
® and © Optimum Resource, Inc.
Apple 12116
Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder
® and © Optimum Resource, Inc.
Apple 12116

Car Builder
® and © Optimum Resource, Inc.
Apple 12116

Car Builder
® and © Optimum Resource, Inc.
Apple 12116
Optimum Resource, Inc. • Norfolk, CT 06058


Optimum Resource, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Nor

MADE IN USA

Optimum Resource, Inc. • Norfo

MADE IN USA

Car Builder

Optimum
Resource
Software

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

Optimum
Resource
Software

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

Optimum
Resource
Software

Optimum Resource, Inc. • Norfolk, CT 06058

100% RECYCLABLE
PRINTED IN THE USA
100% RECYCLABLE
PRINTED IN THE USA
100% RECYCLABLE
PRINTED IN THE USA

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Optimum Resource, Inc. • Norfolk, CT 06058

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Car Builder

® and © Optimum Resource, Inc. Apple 12116

Optimum Resource, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Norfolk, CT 06058

source, Inc. • Norfolk, CT 06058

Optim

Optimum Resource, Inc. • Norfolk, CT 06058

MADE IN USA
Optimum Resource, Inc. • Norfolk, C

urce, Inc. • Norfolk, CT 06058

Optimum Resource, Inc. • Norfo